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THE LATE DR. S. S. BHATNAGAR

WE regret to record the death by heart failure of Dr. S. S. Bhatnagar, Director, Scientific and Industrial Research, Secretary, Ministry of Natural Resources and Scientific Research, and Chairman, University Grants Commission, on January 1, 1955, at New Delhi. The following tributes indicate in some measure what the people and, particularly, men of science in India owe to him.—*Editor.*

It was given to Dr. Bhatnagar to fulfil the historic mission of realising the Prime Minister's vision of putting India on the scientific map of the world, and the result can be seen today in the 12 National Laboratories which have sprung up in rapid succession between the years 1950 and 1954.

These have laid the foundations of the country's scientific development in the field of fundamental research. To translate the fruits of research into industrial terms, he conceived the idea of a National Research Development Corporation which he was able to carry into early effect with the active assistance and support of the Prime Minister. His skill as a negotiator is evidenced by the agreements that have been concluded by the Government of India with three of the world's largest oil combines to establish up-to-date refineries in India. It was largely owing to him that a heavy media separation plant was installed in Madhya Pradesh by a leading mining concern for beneficiation of low grade manganese ore.

As Secretary of the Ministry of Education, which post he held on two occasions in addition to his other duties, he gave active support to proposals for the setting up of a school of Asian Languages in Banaras University, raising the emoluments of University Professors and teachers to attract men of the right calibre

and increased financial assistance to Universities through the University Grants Commission of which he was appointed the first Chairman.

Dr. Bhatnagar's was a rich and diverse personality compounded of learning, scientific curiosity, a keen æsthetic sense and personal charm which won him a large circle of friends. He had the gift of organization and of a quick and sound judgment. He will long be remembered for his signal service to the cause of science in India.—*Gazette of India Extraordinary*, Jan. 4, 1955.

In the sudden demise of Dr. S. S. Bhatnagar, India has lost one of its dynamic personalities in the field of science whose labour of love in the cause of scientific research enabled him to establish throughout the length and breadth of the country, National Laboratories with immense potentialities in them. Dr. Bhatnagar showed a rare combination of scientific genius with administrative efficiency and drive so much to be desired in the much-needed avenues of progress in India at present.

It was a rare coincidence that led to the discovery of Dr. Bhatnagar's abilities by the Government of India as early as 1940. He had made a mark as a Professor of Chemistry in the Lahore University by the researches that he had conducted in petroleum and allied products. A company came forward with a magnificent donation of Rs. 5 lakhs to further such research and to be utilised by Dr. Bhatnagar for the purpose. He handed over this sum to the University of Lahore just as many eminent scientists have done in the past for the furtherance of the research project which they so deeply loved.

He was largely responsible to get men of science of international repute to visit this country periodically and to quicken the interest of research workers, young and old, in many fields of scientific activity. The meetings of the Indian Science Congress were enlivened by their presence and Dr. Bhatnagar was in his element in making their stay here both pleasant and profitable. He was connected with many institutions—the Indian Institute of Science, the Council of Scientific and Industrial Research, the several National Laboratories and many scientific associations of note. The Fellowship of the Royal Society was conferred on him in virtue of his eminence as a scientist. Just a year ago, he had taken up the very responsible task of Chairmanship of the University Grants Committee and his zeal and enthusiasm would have certainly contributed to make it an unqualified success. India in general and the scientific world in particular will bemoan the loss of one who had done so much for the furtherance of the cause of science in independent India.—*Dr. A. L. Mudaliar, Vice-Chancellor, Madras University.*

Science is to-day an integral part of modern civilization and it is Dr. Bhatnagar's unquestionable achievement that in the short space of a few years, he conceived and built in India the laboratories which are indispensable for any nation which aspires for leadership in the modern world. He has provided the means whereby the young Indian scientists of to-day and to-morrow can make their contribution to the betterment of this country and its people.

Dr. Bhatnagar was a scientist of great patriotism and zeal for his work, which he pushed forward with exceptional energy and drive. He was a warm-hearted and generous man and a good friend. Although he is no more, he will be long remembered for his great service to Indian science.—*Dr. H. J. Bhabha, Director, Tata Institute of Fundamental Research, Bombay.*

LADY TATA MEMORIAL TRUST SCIENTIFIC RESEARCH SCHOLARSHIPS 1955-56

THE Trustees of the Lady Tata Memorial Trust are offering six scholarships of Rs. 250 each per month for the year 1955-56 commencing from 1st July 1955. Applicants must be of Indian nationality and graduates in medicine or science of a recognized University. The scholarships are tenable in India only, and the holders must undertake to work whole-time under the direction of scientists of standing in a recognised research institute or laboratory on a subject of scientific investigation that must have a bearing either directly or indirectly on the alleviation of human suffering from disease. Applications must conform to the instructions drawn up by the Trust. Candidates can obtain these instructions and other information they desire from the Secretary, The Lady Tata Memorial Trust, Bombay House, Bruce Street, Fort, Bombay-1.

NEW FORMULA FOR VARIATION OF COMPRESSIVE STRENGTH WITH GRAIN ANGLE IN TIMBER

A. C. SEKHAR AND R. S. SHARMA

Forest Research Institute, Dehra Dun

THERE are various formulæ for the variation of timber strength with grain angle (*i.e.*, with the inclination of grain to the direction of applied force in timber). F. Kollmann[3] suggested

$$\sigma_\theta = \frac{\sigma_\parallel \sigma_\perp}{\sigma_\perp \cos^n\theta + \sigma_\parallel \sin^n\theta} \qquad (A)$$

where $\sigma_\parallel$ = the strength value in the direction of grain, $\sigma_\perp$ = strength value in the direction of perpendicular to the grain, θ = the angle between the grain and the direction of the applied force, σ_θ = the strength required (*i.e.*, in the direction making an angle θ with the grain), and n = an exponential term depending on species and varying between 2·5 and 3 for compressive stresses and between 1·5 and 2 for tensile stresses.

This above formula is referred to as Formula A in the succeeding paragraphs.

In Madison, U.S.A.[1,2] the Hankinson Formula, *i.e.*, Formula A with $n = 2$ is used for all types of stresses and species. This is referred to as Formula B in the succeeding paragraphs. Stussi[4] claiming a more convenient formula for designing purposes proposed

$$\sigma_\theta = \frac{\sigma_\parallel \cos^2\theta}{\sqrt{1 + C_1 \sin^2\theta}} + \frac{\sigma_\perp \sin^2\theta}{\sqrt{1 + C_2 \cos^2\theta}} \qquad (B)$$

where C_1 and C_2 are two parameters and the rest are the same as above.

Having studied the applicability of the above formulæ for compressive stresses in *Calophyllum tomentosum* (poon), the following formula is suggested as simpler than any of the above, and may be tried for other species and stresses also.

$$\sigma_\parallel / \sigma_\theta = 1 + P \sin^2\theta \qquad (C)$$

where P is a parameter depending on the species and the stresses, and the rest are the same as above. This formula is denoted in succeeding paragraphs as Formula C.

Experimental.—From a plank 16′ × 2½′ of *Calophyllum tomentosum* (poon), standard sized specimens, each of 2″ × 2″ × 8″, were cut at different angles to grain varying from 0° to 90° at regular intervals of 10°. In each group three pieces were taken. All specimens were conditioned to about to 12 per cent. moisture content. Each specimen was measured and weighed before test. A Lamb's extensometer was so adjusted to the specimen that the gauge length was 6″ leaving 1″ at each end. Specimens were loaded for compression parallel to the length and the deflection of the specimen was directly plotted on a graph sheet with the increasing load as in the standard practice, until the elastic limit was passed. The extensometer was then remvoed and the load at which failure took place was noted. The speed of the machine, during test, remained uniformly 0·024″ per minute as required under standard practice. The load-deflection curves were drawn connecting the plotted points on the graph sheet for each specimen and the elastic limit was noted. The maximum crushing stress, and the crushing stress at E.L. for each specimen were calculated. Their average value for each of the above properties under different grain angles are shown in Figs. 1 and 2.

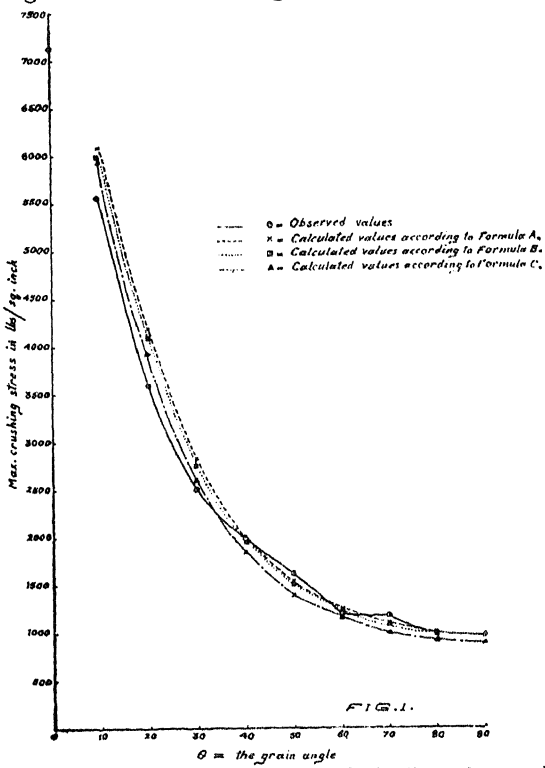


FIG. 1.

Theoretical.—In Figs. 1 and 2, the observed values and the calculated values according to the different formulæ are plotted against various angles of grain to the direction of force for maximum crushing stress and crushing

stress at E.L. In trying to evaluate the required exponential n of the formula A, $\sin^n\theta$ and $\cos^n\theta$ were expanded. Approximation was made correct to the first two terms only involving $\sin^2\theta$ and $\cos^2\theta$. The value of n was thus determined for all angles taking the observed values of $\sigma_{\parallel}$ and $\sigma_{\perp}$. The average value of n was then determined and substituted in

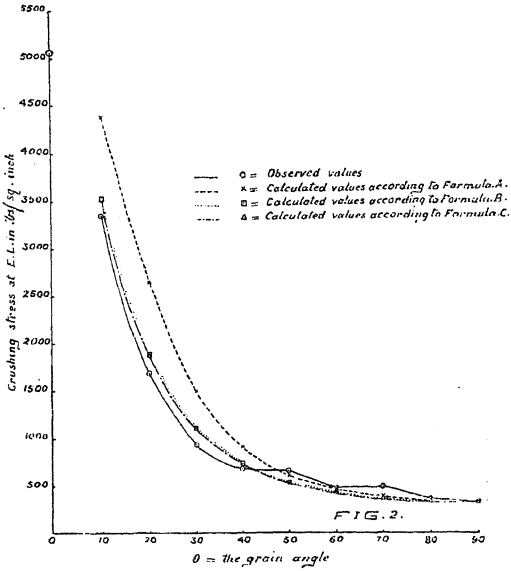


FIG. 2.

the Formula A for getting the calculated values of σ_θ. From Formula B, σ_θ was calculated taking the observed values for $\sigma_{\parallel}$ and $\sigma_{\perp}$.

Stussi's formula was also tried for evaluation of the two parameters C_1 and C_2. In view of the above formula involving two parameters as compared with Formula A, in which there is only one parameter, it was considered that in this case the calculated values would perhaps be closer to the observed values than in any other case. However, the values of C_1 and C_2 could not be easily evaluated as two identical equations involving C_1 and C_2 were obtained in evaluating the parameters either by the method of least squares or by taking any two observed values. Hence this formula was discarded.

With Formula C, the parameter P was determined for all angles taking the observed values of $\sigma_{\parallel}$. The average value of P was then determined and substituted in Formula C for getting the calculated values of σ_θ.

Discussion

It may be noted that in solving the parameter n in Formula A, not only one approximation has to be made at one stage, but also two values are required to be observed (*i.e.*, $\sigma_{\parallel}$ and $\sigma_{\perp}$). In evaluating n for maximum crushing stress the various values of n at the different angles varied from $-63{\cdot}4$ per cent. to $+26{\cdot}8$ per cent. of its average value which worked out to be 2·05. In the case of crushing stress at E.L. the variation was from -23 per cent. to $+75$ per cent. of its average value which worked out to be 2·499. Also after obtaining the average value of n by the above method, the smooth curve of the calculated values does not necessarily pass through the fixed points and the value of n becomes ineffective for these points. Formula B appears to be more universal irrespective of species or condition of timber at test or the nature of stress applied. Formula C is the simplest of the three and required only one observed value for evaluation of its parameter P. Variation of P was from $-18{\cdot}1$ per cent. to $+38{\cdot}5$ per cent. of its average value (*i.e.*, 7·02) in the case of maximum crushing stress and from $-24{\cdot}8$ per cent. to $+23{\cdot}5$ per cent. of its average value (*i.e.*, 14·54) in the case of crushing stress at E.L. Also it was found from the graphs between observed and calculated values for crushing stress at E.L. and for maximum crushing stress (not reproduced here), the scatter as well as the slope of lines fitted by the method of least squares were the best in the case of Formula C. The sum of the squares of the difference between the observed values and calculated values is least in the case of Formula C than in the other two cases. It is to be hoped that Formula C being simplest, may find applicability with sufficient or even greater accuracy than the other two. However, further experiments are required to be done on other species and different types of stresses for a more conclusive evidence.

1. Brown, H. P., Panshin, A. J. and Forsaith, G. G., *Text-book of Wood Technology*, 1952, **2**, 237, McGraw Hill.
2. Hansen, H. J., *Timber Engineers' Handbook*, 1948, John Wiley & Sons.
3. Kollmann, F., *Technologie des Holzes und der Holzwerkstoffe*, 1952, **1**. Springerverlag, Berlin, Heidelberg, Gottingen.
4. Stussi, *Engineers' Digest*, **7** (3), 59.

TENTH INTERNATIONAL CONGRESS OF MATHEMATICIANS*

THE First International Congress of Mathematicians was held in Chicago 71 years ago and 25 mathematicians attended it. The Tenth Congress held at Amsterdam was attended by more than 2,000 ordinary and associate members. Forty-five countries including Russia participated in it; no Chinese delegate attended. The Congress represented a beautiful cross-section of the whole mathematical world, and showed how unity of purpose at a scientific level could get rid of all differences in caste, creed, colour and politics. Nineteen Indians registered themselves for the Congress, but only twelve attended. A number of them were already on the continent attending post-graduate courses. Prof. K. Chandrasekharan of the Tata Institute of Fundamental Research, Bombay, and Prof. B. R. Seth of the Indian Institute of Technology, Kharagpur, attended it as delegates of the Government of India.

In his Presidential Address, Prof. Shouten pointed out that there was hardly an activity in modern society which did not require the help of mathematics. A great responsibility had therefore come to rest on the shoulders of the mathematician. In the last two decades mathematics had played a great part in all technological advances and a large number of social and economic developments. In fact, as sciences grew to perfection they became mathematical. Thus had arisen the need for a large number of trained mathematicians in every branch of the subject.

In the afternoon Prof. J. von Neumann gave an address "On Some Unsolved Problems in Mathematics", a topic dealt with in a similar Congress by Hilbert in 1900. He discussed some problems of linear operation theory in non-compact spaces and ended with the suggestion that the logistic and probabilistic viewpoints may be brought together by developing them from the same set of axioms.

From September 3 to September 9, the Congress split itself into many sections and subsections, sometimes as many as twelve working simultaneously. The following represents a cross-section of what was actually presented at the meetings.

E. C. Titchmarsh gave an account of the work done on eigenfunction problems arising from differential equations of the type $\Delta^2\phi + [\lambda + f(x, y)]\phi = 0$. These problems arise out of Schrodinger's wave equation and have been extensively given by him in current journals. The classical method of residues is used and no general theory is employed.

Harishchandra gave an account of the work done of representation of semi-simple Lie groups. E. Stiefel showed how second order scalar procedure may be adopted in relaxation methods. He gave an account of the first order iteration method and discussed in detail the gradient method for error measure at each stage. Taking the linear equation in the matrix form $Ax = k$ and assuming that A is symmetric and positive-definite he showed how the error measure may be determined at each state —a problem which has become important in view of the widespread use of relaxation methods. As a particular case he discussed the hypergeometric relaxation.

M. Reiner described the work of B. R. Seth on second order effects in elasticity. P. G. Bardoni derived some properties of finite strain invariants. A. Weinstein gave an account of axially elliptic and hyprobolic problems in which he and his co-workers have done much lot of work.

B. R. Seth read the papers of his co-workers S. D. Nigam and G. Bandyopadhyay on axis-symmetric and plane compressible flows. In Nigam's paper exact rotational solutions are obtained by transforming the equations such that the solution is made to depend on the linear equation $(D^2 + k^2)\Psi = 0$, D^2 being the Stokesian stream function operator. The solutions for spheroids are obtained in terms of wave cylinder functions and to the existing two boundary conditions another condition of no slip on the boundary is added to obtain the three arbitrary constants. In G. Bandyopadhyay's paper, conditions are investigated for deriving solutions of one-dimensional gas flows through an elastic tube from those for a corresponding rigid tube. The central assumption that the pressure is a function of the cross-section was open to criticism.

In another paper on "Synthetic Method for Compressible Flows", B. R. Seth indicated how the method, which has been used in a number of problems by his co-workers, H. G. Venkatesh, M. K. Jain and J. R. Foote in America, can be employed to investigate compressible

* Held at Amsterdam, Sept. 1 to Sept. 9, 1954.

flow problems. The equations of continuity is reduced to the canonical form

$$\nabla^2\phi_1/\phi_1=\nabla^2\rho_1/\rho_1,\ \phi_1=\rho^{\frac{1}{2}}\phi,\ \rho_1=\rho^{\frac{1}{2}}$$

and it is shown how some problems of uniform compressible flow may be solved. The possibility of using the method for discussing the formation of shocks was indicated.

J. J. Stoker showed how a perburtation technique for non-linear problems applied to shallow water waves gave a number of interesting results including that of the solitary wave.

B. Jessen of Denmark gave some results of the theory of almost periodic functions. He gave an account of Bohr's work and made out that any trigonometric polynominal of the form $\sum a_n e^{i\lambda_n t}$ possessed a mean motion. D. Gilbarg discussed methods in fluid dynamics with special reference to compressible flow. V. G. Szebehely showed that the classical formulation of the motion of a solid through an incompressible liquid was not suitable for free surface and impact problems. Starting with Bernoulli's equation he showed how a set of integral transformations gave the necessary results. A. R. Mitchell gave elementary solutions of shear flow through circular, elliptic and parabolic cylinders.

D. Van Danstzig gave an account of the mathematical problems raised by the floods of 1953, which affected about one-third of Holland. They were of three types—hydrodynamical, statistical and economictrical. Of these the last two were found to be of an elementary type. The hydrodynamical problems presented some interesting features. The area affected was idealized into an infinite medium of uniform depth internally bounded by a rectangle with three sides fixed. The reduced equations of motion were solved with the help of Laplace's transform.

K. Chandrashekharan spoke on localization and uniqueness theorems in Fourier analysis of more than one variable. He showed that results obtained by analogy from one to higher dimensions need not always be correct. Thus arose the need of closely examining all extensions of one-dimensional Fourier series results to multi-dimensional analysis which is used in eigenfunction expansions of solutions of the wave equation. He pointed out a number of unsolved problems.

M. L. Cartwright dealt with non-linear vibrational equations of the type

$$\ddot{x}-k\,(1+\alpha x-x^2)\,\dot{x}+x=pk\cos lt$$

where k is small and α may be small or great. If α is small it is found that the results are unaffected, otherwise there is a marked difference.

S. Goldstein spoke on some methods of approximation in fluid dynamics. He pointed out that for higher approximations we should consider the fluid as a whole and not simply the boundary layer. He discussed the case of parabolic cylinder in detail and doubted if the irrotational and the boundary layer solutions could be patched together to give one solution. In this connection mention may be made of the synthetic method for flow problems which gives a continuous pattern for the whole fluid, including the boundary layer. This is being developed at the Indian Institute of Technology by B. R. Seth and his co-workers.

A large number of other papers on algebra, theory of numbers, analysis, geometry and topology, probability and statistics, mathematical physics and applied mathematics, logic and foundations, philosophy, history and educations were also read.

On the closing day, September 9, A. N. Kolmogorov of Russia spoke on general theories of dynamical systems and classical mechanics. The Congress ended after deciding that the Eleventh Congress of Mathematicians be held in 1958 in Edinburgh in the month of August.

B. R. Seth.

RECESSION OF STARS

Reporting on studies made on the recession of stars over the past 20 years, Dr. Allan R. Sandage, of the Mount Wilson and Mount Palomar Obsevatories, observes that the observations made by himself, Dr. M. L. Humason, of Mount Wilson and Mount Palomar, and Dr. N. N. Mayall, of the Lick Observatory of the University of California have gone as far as the Hydra Cluster, roughly 333 million parsecs. The speed of the recession is 180 kilometres for each million parsecs, a parsec being 3·3 light years.

The Hydra Cluster was found to be receding from the earth at one-fifth the speed of light. This system is the farthest in space so far measured, but there is hope that existing equipment will make it possible to extend the measurements to objects receding at one-third the speed of light, or distances of 550 million parsecs.

RECENT DEVELOPMENTS IN MOLECULAR SPECTROSCOPY*

RELIABLE determination of the molecular constants is of great importance for many applications as well as for progress in the theoretical understanding of molecular structure. In recent years increasingly accurate determinations of molecular constants of diatomic molecules are being made by microwave absorption spectra and by the more powerful spectrographs and improved techniques available now.

Because of the very high resolving power available in the microwave technique it has been possible to obtain with great accuracy the rotational constants of a large number of different types of poly-atomic molecules and also several diatomic molecules such as CO, ICl, etc. It has been also possible to study the hyperfine structure of rotational spectra, and to obtain nuclear spin, electric quadrupole moment and isotopic mass-ratios. Similarly in microwave and radio-frequency magnetic resonance spectra applied to molecular beams, transitions between the hyperfine structure components in a magnetic field give the nuclear magnetic moments. The electric analogue of the magnetic resonance method gives electric dipole moments, moments of inertia and quadrupole interactions. Similar methods are also employed with atomic beams. Other methods such as nuclear magnetic resonance, nuclear induction and nuclear quadrupole resonance have been applied to liquids and solids as well as for gases for the study of nuclear properties.

Much work remains, however, to be done in diatomic spectra with regard to molecules that have not yet been investigated and with regard to new electronic states of known molecules. A whole lot of spectra involving multiplicities greater than three awaits attention. In the vacuum ultraviolet, Rydberg series for many diatomic molecules have yet to be studied.

In the case of polyatomic molecules, isotopes are useful for the species classification of frequencies. Particularly profitable has been the use of deuterium. It has twice the mass of hydrogen which it displaces and therefore gives rise to pronounced effects on the vibrational spectra of the molecules. So also, in the study of rotational levels using microwave spectroscopy, it becomes necessary, to use isotopic species of the molecule, because of the structural complexity of a polyatomic molecule. Now that elements enriched with any desired isotope are available from atomic piles, it is possible to increase the efficiency of the method of microwave spectroscopy, with its enormous resolution and dispersion. At present microwave spectroscopy offers the only method which can be employed for obtaining the spins, isotopic mass ratios, quadrupole moments and coupling constants, of the nuclei of radioactive elements of short life and low concentration which are important for nuclear physics.

Experimental investigation and theoretical development of the electronic spectra of polyatomic molecules are still in the exploratory stage. Because of the instability of an excited polyatomic molecule it has been very difficult to excite emission spectra. Nearly the same situation exists with regard to fluorescence spectra. It is only in a few cases that emission spectra have been observed. Emission in benzene derivatives excited by electron impact and in the positive column of a specially designed discharge tube in the presence of rare gases has been studied in recent years by Schuler and collaborators. The interpretation of the results is not yet very clear. Emission bands that correspond to the known absorption bands of the molecule have been obtained in benzene, toluene, aniline and several other organic aromatic molecules by Asundi and his coworkers.

* Excerpts from the Presidential Address to the Physics Section of the Indian Science Congress, Baroda, 1955, by Professor R. K. Asundi.

FLOWERING IN PLANTS*

TWO environmental factors, light and temperature, have marked influence on the onset of reproductive phase in plants. Flowering in some plants may be hastened or delayed by presowing temperature treatment; in some others, a minimum period of darkness and some light is required; there are also a few which are apparently independent of such requirements.

Under suitable conditions of light and/or darkness, some compounds are formed in the leaves which are transported to the growing points where floral primordia are formed. The stimulus is transmissible through graft partners

* Abstract of Presidential Address to the Botany Section of the 42nd Session of the Indian Science Congress, by J. C. Sen Gupta on "*Control of Flower Initiation in Plants*".

and is probably the same for plants of different flowering behaviour. The success claimed by various workers in extracting the active substance has not been reproduced.

There are at least three simpler processes concerned with the perception of the stimulus. There is a high intensity light process (requirnig ca. $6{\cdot}6 \times 10^4$ of light energy) which must precede a dark period but can be bypassed by administering sugars or some Krebs cycle acids. With tracer carbon (C^{14}) it has been shown that such compounds are synthesised in light and metabolised in darkness as the dark period becomes longer, supplying substrates for the ultimate synthesis of the "flowering hormone", if any. The dark reaction can be inhibited by a flash of light in the middle of the dark period; this is a low intensity light process probably not identical with photosynthesis. The pigment which perceives the stimulus is probably of phycocyanin type having absorption maximum at 6,600 Å convertible into an isomer absorbing maximum at 7,350 Å. The pigment is also present in lettuce seed, oat mesocotyls, eliolated pea internodes and tomato cuticle.

Low concentrations of auxin inhibit the flowering of short-day plants, while promoting that of some long-day plants; higher concentrations are inhibitory to both. It has been suggested that the auxin level in plants may be the controlling factor in floral initiation. For short-day plants a low auxin level appears to be conducive to reproduction. The possible factors which may reduce the auxin level are the activities of naturally occurring inhibitors, indolacetic acid oxidase, enzymes concerned with the synthesis of indoleacetic acid—the native auxin and X-radiations. Synthetic auxin-inhibitors like 2, 3, 5-triiodobenzoic acid, 2, 4-dichloranisole, etc., counter the inhibitory effect of auxins and promote flowering under non-inductive daylengths. There is good evidence, however, that the effect is indirect and auxins probably act by influencing the metabolic pathways concerned with the synthesis of the flower forming substance.

Recent investigations on CO_2 fixation indicates that CO_2 is essential during the dark inductive period for floral initiation in short-day plants. *Kalanchœ blossfeldiana*—a succulent, fixes CO_2 vigorously in the dark as the induction treatment is prolonged but this CO_2 is evolved as soon as the plants are subjected to light. Using $C^{14}O_2$ it has been shown that the dark fixation pattern in short- and long-day plants is different, the rate of photosynthesis is influenced strongly and new compounds are formed in light photosynthetically and non-photosynthetically. The rate of steady state photosynthesis in induced plants is increased to seven times that of the vegetative plants, and there are qualitative and quantitative differences in the products formed. C^{14} labelled compounds have been traced to the growing points.

The most promising line of study appears to be the isolation of the flower-forming substance or a synthetic compound capable of bringing vegetative plants into flowers.

RADIOACTIVITY OF THE HUMAN BEING

THE amount of radioactive substances deposited naturally in the normal human being has become one of the key figures in recent discussions on "tolerance" dose, "permissible" dose and "damaging" dose in repeated, as well as in single, total body exposures to ionizing radiations. Its magnitude, originally reported by Krebs as close to the accepted permissible body content of 1×10^{-7} g. radium element permanently fixed in the body, became uncertain, when Hursh and Gates in 1950 found values 100 to 1,000 times smaller than the accepted permissible content. While the reasons for this discrepancy were under discussion, Sievert in 1951, using a special gamma ray sensitive device for measurements on the intact living body as a whole, reported an average radioactivity of the human being close to the values given by Krebs and thus close to the permissible content.

New data on this subject have been reported by Burch and Spiers and reviewed by Krebs in *Science* (1954, 120, 719). Krebs observes that in order to promote knowledge in the field, the following studies would seem to be necessary:

(*i*) Measurement of the radioactivity of as many people as possible from different regions of the globe with the modern total-body activity measuring devices. (*ii*) Measurement of the kinds of radioactive substances in the body, especially with regard to α-emitting, β-emitting and/or γ-emitting elements. (*iii*) Detailed investigations of the radioactive materials incorporated daily by human beings from air, water and food.

NUCLEAR SPECIES*

THE study of the properties of various nuclides has been systematically pursued during recent years and a great many interesting results have been obtained. While most of these have been presented in papers and specialised review articles, a comprehensive elementary presentation of the whole field has been lacking. The timely appearance of Professor Huntley's lucidly written book will hence be welcomed widely.

Throughout the book, the need for viewing the entire collection of nuclides as a whole is stressed. The chart presenting nuclides with charge number against neutron number (Z-N diagram) is shown to be of basic significance much in the manner of the periodic system of elements to the chemist. The happy choice of descriptive phrases like "valley of stability", "northwestern slope", etc., would doubtless assist the beginner in retaining the mental picture of the Z-N diagram in relief. The usefulness of this method of presentation is elegantly brought out in the discussion of the stability of neighbouring isobars and of the connection between mass defects of neighbouring nuclides and their $\beta^{\pm}$, K activities. The deduction of the general properties of the "missing" element Z = 43 (technitium) is an interesting case.

The meaning of various concepts like "binding energy", "isomerism", etc., are clearly given; and illustrative numerical examples will give the student a feeling of the subject.

The observed general properties of the nuclides are given in the form of empirical "rules", thirteen in all, five of them applying only to stable nuclei. While they are of value in giving a summary of the general characteristics, it is doubtful whether the student would be able to retain the "rules" as such. The reviewer feels that the excellent tabulations of otherwise not easily obtainable data is of much greater value.

A trend to oversimplification is apparent in the theoretical arguments, the worst example being in the attempt to explain the saturation property of nuclear forces. This is perhaps responsible in part for certain omissions. For example, in talking of Bohr's model of the atom, the radical nature of the assumption of non-radiating accelerated orbits which is in direct contradiction with classical electromagnetism is not even mentioned; similarly, the necessity to invoke the quantum mechanical tunnel-effect to account for the finite lifetime of α-decaying nuclei. But the omission of the π°-meson, with its well-known 2-photon decay (when a hypothetical ν-meson is postulated) from the list of elementary particles is inexplicable. The nuclear magnetic resonance technique of Bloch for the precision measurement of nuclear spins is also missing.

In the section on the origin of elements, the neutron capture theory is well presented, but rival theories are not even mentioned. A more substantial discussion of geo-chemistry and cosmo-chemistry would have been welcome. The tendency to one-sidedness is also evident concerning the "size" of the nucleus. The constant r_0 in the relation $r = r_0 A^{1/3}$ cm. from electron scattering by nuclei has been completely overlooked.

Apart from these defects, which can easily be remedied in the next edition, the book is a definite success. Intended for honours students of the British Universities, it is heartily recommended to the Second Year Honours student and the First Year Post-Graduate of the Indian Universities. The Post-Graduate student of Chemistry will also profit by reading the book; and the research worker beginning to specialise in experimental nuclear physics will find it an excellent elementary introduction.

E. C. GEORGE.

* By H. E. Huntley. Macmillan & Co. Ltd., London, 1954. Pp. xix + 193. Price not given.

WINDS AT HIGH ALTITUDE

TESTS have been carried out in Australia on the behaviour of winds up to a height of 65 miles, by a research team working under the direction of Professor Huxley of the Adelaide University.

Previous knowledge of upper atmosphere winds was confined mainly up to 40 miles. The present tests have shown that winds reach a speed of 200 miles an hour at 62 miles height, and that they get faster in summer and slower in winter as altitude increases. They flow from east to west in summer and in the reverse direction in winter. Tidal winds have also been discovered which are caused by pulsations of the earth's atmosphere under the heat of the sun.

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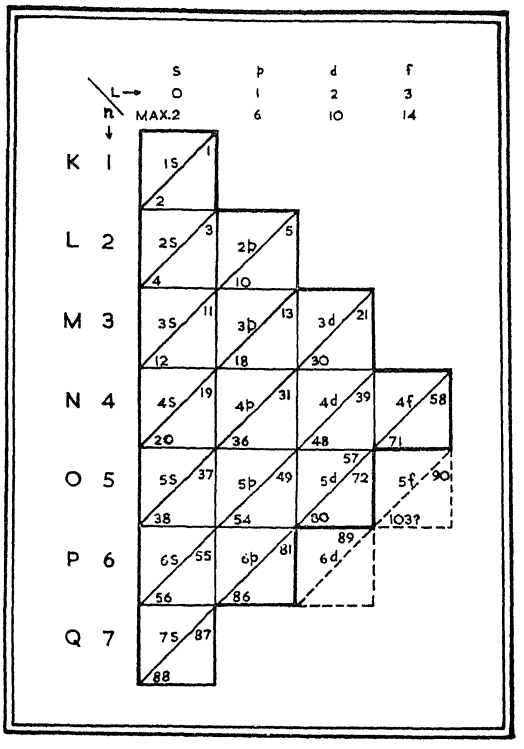
THE NORMAL ELECTRON CONFIGURATIONS OF ATOMS

THE pattern of squares shown here, which can easily be constructed, will help one to write down quickly the ordinary electron configuration for any atom Z, in the normal state. The rows of squares taken horizontally represent the K, L, M, - - - shells of total quantum number $n = 1, 2, 3, - - -$ respectively. The squares are designated 1 *s*; 2 *s*, 2 p; 3 *s*, 3 *p*, 3 *d*; etc., in the usual way.

Diagonal lines are drawn as shown, starting from the left bottom corner of an '*s*' square and terminating at the farthest right top corner in each case. To get the sequence in which the shells and sub-shells are formed one has to go down the diagonal lines from top to bottom starting with the first line, proceeding to the second, then to the third and so on.[1] Thus the sequence will be 1 *s*; 2 *s*; 2 *p*, 3 *s*; 3 *p*, 4 *s*; 3 *d*, 4 *p*, 5 *s*; 4 *d*, 5 *p*, 6 *s*; 4 *f*, 5 *d*, 6 *p*, 7 *s*.

Knowing that the maximum number of electrons in *s*, *p*, *d*, *f* shells are 2, 6, 10, 14 respectively, as indicated at the top of each column, the atomic number Z can be written in the serial order down each diagonal, as shown by the first and last numbers only in each square. Thus in the 4 *d* square 39 and 48 indicate that the first 4 *d* electron starts in element Z = 39 and the 4 *d* shell gets completed with $4d^{10}$ in Z = 48. Exceptions to the general sequence can also be indicated, as for example 57 in the 5 *d* square which means that after 6 s^2 in Z 56.

the 57th electron becomes a 5 *d*, and the 4 *f* starts with Z 58.



The trans-radium and the trans-uranium elements can be included by adding the 5 *f* and the 6 *d* squares to the pattern. These are shown by the dotted lines.

Mahakoshal Mahavidyalaya, A. S. GANESAN.
Jabalpur, *September* 30, 1954.

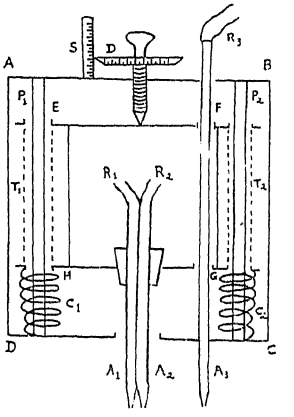
1. Therald Moeller, *Inorganic Chemistry*, 1952 (John Wiley), 97.

MEASUREMENT OF SURFACE TENSION

A COMPACT and accurate instrument for the measurement of surface tension of liquids has been devised by the authors. It is based on the maximum bubble pressure method. ABCD is the main box in which the frame EFGH moves up and down by moving the graduated drum D. The motion of EFGH is guided by the rods P_1, P_2. The tubes T_1 and T_2 attached to EFGH fit the rods exactly. The springs C_1, C_2 help the motion of the frame when the drum is moved upwards.

A_1, A_2, A_3 are three hollow glass tubes with drawn ends. The tube A_3 is fixed in position while A_1, A_2 move with the frame EFGH. The tubes are joined to a source of compressed air by the rubber tubes R_1, R_2, R_3. The tubes A_1, A_2 carry stop cocks so that they can be opened at will.

The tubes are immersed in a beaker of liquid whose surface tension is required. In the beginning, A_1 is open and A_2 closed. The bubbles will come out either from A_1 or A_2. The drum D is then moved until the bubbles come out simultaneously from A_1 and A_3, and the reading on the drum noted. A_1 is then closed and A_2 opened, and the drum is again adjusted until the bubbles come out simultaneously from the two. This reading on the drum is also noted.



The maximum pressure of the bubble is given by

$$P_{max.} = gd\rho + 2\gamma/r$$

where d is the depth of the tube in the liquid, ρ the density of the liquid, γ the surface tension and r the radius of the bore of the tube.

When the bubbles come out simultaneously from A_1 and A_3, we write

$$gd_1\rho + \frac{2\gamma}{r_1} = gd_3\rho + \frac{2\gamma}{r_3}$$

$$g\rho\,(d_1 - d_3) = 2\gamma\left(\frac{1}{r_3} - \frac{1}{r_1}\right) \qquad (1)$$

Similarly for A_2 and A_3, we have

$$g\rho\,(d_2 - d_3) = 2\gamma\left(\frac{1}{r_3} - \frac{1}{r_2}\right) \qquad (2)$$

From (1) and (2) we get

$$g\rho\,(d_1 - d_2) = 2\gamma\left(\frac{1}{r_2} - \frac{1}{r_1}\right)$$

or

$$\gamma = \frac{g\rho\,(d_1 - d_2)}{2\left(\frac{1}{r_2} - \frac{1}{r_1}\right)} = K\cdot\rho\cdot(d_1 - d_2)$$

where K is the constant of the instrument.

Typical results for benzene are given below.

K (as determined from observations on water) = 44·59 ; ρ = 0·8675 gm./c.c. ; temperature = 30° C.

$d_1 - d_2$ cm.	γ dynes/cm.
0·7115	27·53
0·7095	27·45
0·7095	27·45
0·7100	27·48
0·7115	27·53
0·7125	27·57
Mean	27·50

This may be compared with the accepted value 27·56 for benzene.

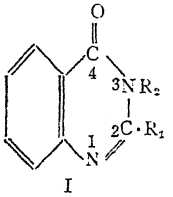
The instrument is now being used by the authors to study the surface tension of certain solutions.

M. G. Science Institute, Navarangpura, Ahmedabad-9, *November* 18, 1954.

G. M. SHAH.
P. D. PATHAK.

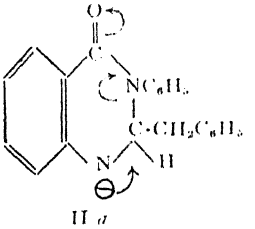
REACTION OF 2-ETHYL-3-PHENYL- AND 2-ETHYL-3-*p*-TOLYL-4(3H)-QUINAZOLONES WITH PHENYLMAGNESIUM BROMIDE

KOELSCH[1] identified the reaction product of 3-phenyl-4(3H)-quinazolone (I *a*) with benzylmagnesium chloride as N-(β, β'-diphenylisopropyl)-anthranilanilide (III). He explained the course of reaction by postulating that an electrophilic centre is developed at C-2 of I *a* under the conditions of the reaction, whereby, R of R^-MgX^+ attacks at this carbon atom to form the intermediate (II *a*). This intermediate through a more stable form (II b) yields III by the addition of another molecule of the Grignard reagent at the aldimine linkage of II *b*. Sen and Sidhu[2] and Sen and Upadhyaya[3] reported the formation of 3, 4-dihydro-2, 3, 4-trisubstituted-quinazolinol (named as 4-quinazolols by the authors) when I b, I c, or I *d* was reacted with phenyl-, *n*-propyl-, or *n*-butylmagnesium halide. The course of reaction was attributed to the normal reaction at the $>C=O$ grouping at C-4 of the quinazolone.

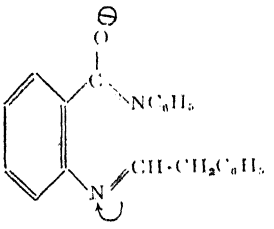


I

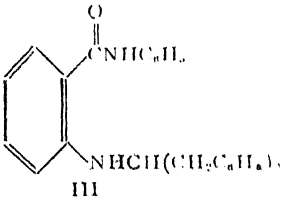
(*a*) R_1 = H ; R_2 = C_6H_5
(*b*) R_1 = CH_3 ; R_2 = C_6H_5
(*c*) R_1 = CH_3 ; R_2 = $CH_3CH_2CH_2CH_2$
(*d*) R_1 = CH_3 ; R_2 = α-naphthyl
(*e*) R_1 = C_2H_5 ; R_2 = C_6H_5
(*f*) R_1 = C_2H_5 ; R_2 = *p*-Tolyl



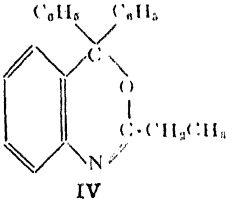
II *a*



II *b*



III



IV

In our experiments, when 2-ethyl-3-phenyl or 2-ethyl-3-*p*-tolyl-4(3 H)-quinazolone[4] (I *e*, I *f*) was reacted with phenylmagnesium bromide, the main product of the reaction in each case was the same colourless crystalline solid, m.p. 154-55°, yielding identical picrates, m.p. 186-87° and picrolonates, m.p. 177-78° (decomp.). Besides this product, aniline or *p*-toluidine (identified through their acetyl derivatives) was also isolated from the Grignard reaction mixture, depending on the substituent at C-3 of the starting quinazolone.

The solid (m.p. 154-55°) could not be acetylated and gave a negative Liebermann nitroso reaction. When hydrolysed with 15 per cent. hydrochloric acid, it gave the following identifiable products : 2-aminophenyldiphenylcarbi-

nol,[5] m.p. 121-22° (identified through its N-acetyl derivative,[6] and also by admixture with an authentic sample), benzophenone and aniline. The structure of the product therefore seemed to be IV and this was confirmed through its preparation by reacting 2-aminophenyldiphenylcarbinol with *n*-propionic anhydride in the presence or absence of fused sodium acetate, m.p. 154-55° (Found Mol. wt. 315; C, 84·4; H, 6·2; N, 4·7. Calculated for $C_{22}H_{19}ON$: Mol. wt. 313; C, 84·4; H, 6·1 and N, 4·5).

Since the abovementioned results are in conflict with those reported by Sen and Upadhyaya,[3] the reactions of 2-methyl-3-aryl-4(3H)-quinazolones with Grignard reagents are under reinvestigation.

Central Labs. for Scientific & Industrial Research, Hyderabad-Deccan, *July* 12, 1954.

S. H. Zaheer.
I. K. Kacker.

1. Koelsch, C. F., *J. Amer. Chem. Soc.*, 1945, **67**, 1718.
2. Sen, A. B. and Sidhu, G. S., *J. Indian Chem. Soc.*, 1948, **25**, 437.
3. Sen, A. B. and Upadhyaya, M. P., *Ibid.*, 1950, **27**, 40.
4. Kacker, I. K. and Zaheer, S. H., *Ibid.*, 1951, **28**, 344.
5. Baeyer, A. and Villiger, V., *Ber.*, 1904, **37**, 3192.
6. Lothrop, W. C. and Goodwin, P. A., *J. Amer. Chem Soc.*, 1943, **65**, 363.

CONSTITUTION OF LANCEOLATIN C AND LANCEOLATIN B

From the root bark of *Tephrosia lanceolata* Grab., three crystalline substances were isolated by Rangaswami and Sastry and designated lanceolatin A, lanceolatin B and lanceolatin C.[1,2] Studies on the constitution of the two latter compounds have been completed now. The salient results are given below:

Alkaline fission of lanceolatin C under varied conditions yielded benzoic acid, o-methylkaranjic acid and acetophenone (isolated as the 2 : 4-dinitrophenylhydrazone). Benzoic acid was formed also by treatment with neutral potassium permanganate. The formation of these three substances and other properties of lanceolatin C lead to the structure o-methylkaranjoylbenzoylmethane for this substance. The same structure has recently been deduced for pongamol, a compound obtained from the oil of *Pongamia glabra*.[3,4] This fact and the fact that the reported m.p.'s of pongamol and lanceolatin C are very close or almost the same suggested their probable identity. The mixed m.p. was therefore determined and it was found to be undepressed, thus substantiating the conclusion reached on other grounds.

Lanceolatin B also yielded benzoic acid and acetophenone by alkaline degradation, but in place of o-methylkaranjic acid obtained from lanceolatin C, lanceolatin B yielded karanjic acid. Two more products were also obtained and characterised as 4-hydroxy-5-acetylcoumarone and karanjoylbenzoylmethane. These fission products, taken together with the insolubility of lanceolatin B in alkali and its recovery without change under conditions of acetylation and methylation, lead to the structure 7 : 8 (2′ : 3′)-furanoflavone for this compound. Corroboratory evidence for this conclusion was furnished by the formation of lanceolatin B when lanceolatin C was subjected to demethylation by treatment with hydrogen bromide in glacial acetic acid.

The analyses recorded for lanceolatins B and C in the earlier publications[1,2] and augmented later on are compatible with the structures deduced above, but the molecular formulæ suggested earlier in analogy with well-known rotenoids become obsolete in the light of the present findings.

Dept. of Pharmacy, Andhra University, Waltair, *September* 16, 1954.

S. Rangaswami.
B. V. Rama Sastry.

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ACTION OF FOSSIL WOOD ON PHOTOGRAPHIC PLATE

Previous investigations by the author[1] have shown that Indian woods possess the property of reacting on a photographic emulsion and imprinting thereon its image. The study has since been extended to fossil woods. The fossil wood used for this experiment belonged to the Upper Cretaceous period, and was lent by the Department of Geology, Presidency College, Madras. Its age is estimated to be near about 90 million years.

The specimen was placed in contact with the sensitised surface of a photographic plate in darkness and allowed to remain on it for a period of 48 hours. On processing the plate in the usual way, a clear image of the fossil was found imprinted on the emulsion.

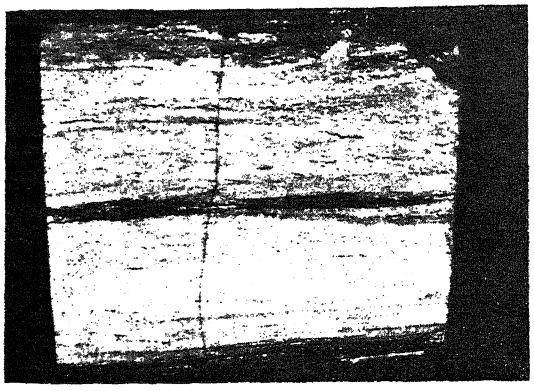


FIG. 1

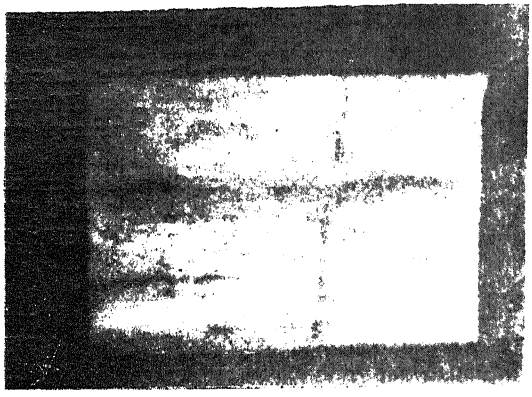


FIG. 2

Fig. 1 represents an actual photograph of the fossil taken with a camera, and Fig. 2 the picture recorded by it in darkness on the photographic plate.

It is common knowledge that some fossils exhibit traces of radio-activity. In order to ascertain whether the observed phenomenon was a case of true Russel Effect, extremely thin sheets of mica, and cellophane paper were interposed between the photographic plate and the specimen, when there was no trace of any action in the regions covered by the paper. However, the effect persisted when the plate and specimen are separated by a small distance and also when a sheet of filter paper is interposed between them. It seems certain that radio-activity is not therefore the cause for this action. Further, the fossil had no action on panchromatic plates, like the H.P.S. and H.P. 3, which is similar to the behaviour of ordinary woods in Russel effect. However, fossil wood seems to differ from ordinary wood in that it does not exhibit a marked increase in activity after irradiation by sunlight.

The author's thanks are due to the Government of India for sanctioning a grant to conduct this investigation.

Dept. of Physics, V. P. NARAYANAN NAMBIYAR.
Pachaiyappa's College,
Madras-30,
November 19, 1954.

1. Narayanan Nambiyar, V. P., *Curr. Sci.*, 1949, **18**, 284; 1951, **20**, 290; 1952, **21**, 182; 1952, **21**, 289.

PHYLLOTRETA CHOTANICA DUVIVIER, A NEW PEST OF MUSTARD IN WEST BENGAL

Phyllotreta chotanica Duviv., has been noted for the first time as a pest of mustard in West Bengal. An outbreak of this pest was observed last year at Mathurapur, under district 24 Parganas, West Bengal.

The genus Phyllotreta, belonging to the family Halticidæ, comprises a large number of destructive species enjoying a worldwide distribution and most of them are notorious pests of the Cruciferous plants.

The species *Chotanica* was first described by Duvivier[1] in 1892 from Bengal. Shroff[2] recorded it as a minor pest of mustard, cabbage, cauliflower and radish from Burma. In India, it was noted in small numbers on cabbage at Pusa (Fletcher[3]). There seems to be no other record of the species as a pest.

The beetle is small and oblong, measuring about 2 mm. in length, the colour of the upper side being metallic bronze with bluish reflections. The interantennal ridge sharply elevated, vertex without punctures. Antennæ black, extending a little beyond the middle of the elytra. Prothorax broader than long, closely covered with punctures, scutellum small and triangular. Elytra closely covered with punctures and the posterior part of the surface without ribs.

The beetles attacked mustard in the late stage of development of the crop, making small holes in the leaves and fruits. No control measure was adopted against the pest in order to study the extent of damage, which was found to be severe. The affected plants gradually dried up and consequently the yield was negligible.

Thanks are due to the Commonwealth Institute of Entomology, for kindly identifying the insect and to Miss Gopa Konar, for drawing the sketch.

SAURENDRA NATH BANERJEE.
ADYANATH BASU.

State Agric. Res. Inst.,
Tollygunge, Calcutta,
August 30, 1954.

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APANTELES PHYTOMETRAE WILKINSON, A NEW LARVAL PARASITE OF SUGARCANE STEM BORER

WHILE searching for a suitable parasite for the control of sugarcane borers, the authors recorded this insect as a new addition to the list of parasites so far published. In August, 1953, *Apanteles phytometræ* Wilkinson, was noted to parasitise the larvæ of the sugarcane stem borer, *Chilotræa infuscatellus* S., at the Seed Multiplication Farm, Burdwan.

The genus *Apanteles* comprises a large number of species many of which have been recorded as parasites of various crop pests. *A. flavipes* Cam. has already been established as a parasite of different sugarcane borers in the Punjab, U.P., Behar and Madras.

The species *Phytometræ* was first described by Wilkinson in 1928 and it derives its name from two noctuid moths, *Phytometra chalcites* Esp., and *Phytometra signata* F., on which it was bred by Buxton (Wilkinson[1]).

The parasites are black in colour. Palpi, the 4 anterior legs (except their coxæ and trochanters), basal half of the hind tibiæ, basal joint of the hind tarsi at extreme base, basal ventrites, lateral membraneous margins of the first and second tergites, lightly reddish testaceous; hind femora, apical half of hind tibiæ, remainder of hind tarsi, tegulæ, antennæ, stigma, metacarp-dark red brown. Mesonotum sparsely and finely punctate (degree 2), propodeon largely smooth basally. First tergite indefinitely sculptured in the apical fourth. The lateral bounding sulci of the second tergite are straight.

The insect is an ectoparasite and cocoons were formed on the dead larvæ.

Thanks are due to the Commonwealth Institute of Entomology for kindly identifying the specimen.

State Agric. Res. Inst., S. N. BANERJEE.
Tollygunge, A. L. MOOKERJEE.
Calcutta-40, *September* 21, 1954.

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EFFECT OF LUCERNE SUPPLEMENT TO THE RICE DIET ON THE BODY COMPOSITION OF GROWING RATS

IN an earlier communication[1] it was reported that the rate of growth of rats receiving the poor rice diet is nearly trebled on incorporating 4 per cent. (on dry weight) of lucerne leaf-flour. Considering the amount of supplement fed, the increase in growth rate was remarkable. Growth rate as usually measured by increase in weight is not, however, adequate indication of well proportioned body growth. It was of interest therefore to measure the 'chemical growth' of the animals in order to corroborate the earlier results on measurements by 'physical growth'.

Two groups of freshly weaned rats (3 males and 3 females in each group) were fed *ad libitum* for a period of eight weeks on, (*i*) the poor South Indian rice diet, and (*ii*) the same diet in which rice was replaced to the extent of 4 per cent. by an equivalent amount of lucerne (*Medicago sativa* Linn.) leaf-flour. At the end of the experimental period, the animals were anæsthetized and the alimentary canal emptied of residual food and fæcal contents. The carcasses were weighed to obtain the 'net body weight', minced twice in a meat mincer and stored under alcohol in separate bottles. The minced carcasses were subsequently refluxed twice with alcohol, once with alcohol-ether mixture and then with ether alone. The pooled extracts were collected and freed of solvent. For obtaining the total body lipids, the fatty residue was redissolved in petroleum ether, filtered, evaporated, dried and weighed. The residue insoluble in petroleum ether was added to the solvent extracted carcass, dried at 95-100° C. and weighed as non-lipid solids. Nitrogen (macro-Kjeldahl method), ash and calcium in the non-lipid solids were determined by the usual methods.

The absolute values for each of the body constituents were very much higher in the animals receiving lucerne than in the control

group. For purposes of comparison, the values were calculated as per 100 g. net body weight and are presented in Table I.

TABLE I

Effect of lucerne supplement on the body composition of growing rats

(Figures represent average of six values)

	GROUP I (poor rice diet)	GROUP II (poor rice diet + 4% Lucerne)	Significance
Body weight (g.)	79·3 ± 2·85	126·2 ± 8·05	..
Body water (%)	68·5 ± 0·74	64·4 ± 1·05	†
Body solids (%)	31·5 ± 0·74	35·6 ± 1·05	†
Body lipids* (%)	8·7 ± 0·48	12·7 ± 0·82	†
Non-lipid solids (%)	22·8 ± 0·52	22·9 ± 0·59	n.s.
Body ash (%)	3·25 ± 0·050	2·79 ± 0·088	†
Body calcium (mg. %)	614 ± 20·2	759 ± 23·7	†
Protein (N × 6·25) (%)	16·1 ± 0·49	15·9 ± 0·65	n.s.
Carbohydrate (by difference) (%)	4·4 ± 0·48	4·2 ± 0·57	n.s.

* Petroleum ether extractives; † Significant at 1% level; n.s. Not significant at 5% level.

It is of interest to note that, as compared with the animals in the control group, those receiving lucerne supplements not only grew at a much faster rate, but also contained significantly greater percentage of total body solids. The higher proportion of total body solids was principally due to an increase in body lipids (petroleum ether extractives). That the content of body lipids was higher in Group II even though there was no difference in the fat levels of the two diets, shows greater storage of body lipids in animals receiving lucerne supplements. Further work requires to be done for elucidating the significance of this observation. Increase in body ash, though small, was significant. The proportions of body protein and non-lipid solids were the same in both the groups.

It is well known that body calcium increases with maturity in growing rats.[2] In separate experiments we have observed that freshly weaned animals contained 0·70 per cent. body calcium. It would thus appear that the body calcium of animals receiving the poor rice diet decreased to 0·61 per cent. by the end of the experimental period. Although the animals receiving lucerne supplements grew at a much faster rate, their body calcium increased to 0·76 per cent. showing thereby better calcification of the bones of growing rats.

Central Food Tech. Res. Inst., B. K. SUR.
Mysore, V. SUBRAHMANYAN.
September 13, 1954.

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OCCURRENCE OF *CHARACIOSIPHON RIVULARIS* IYENG.

THERE have been two reports[1,4] on the occurrence of *Characiosiphon* since Iyengar[3] first discovered and described it from Trichinopoly. During the author's collection of Jodhpur algæ,[2] this variety was found growing in two different habitats in places near about Jodhpur. In August 1951, it was found growing in small clusters on tiny stones, pebbles, decaying twigs, snails and other submerged substrata (not uncommonly even epiphytically) in the Umed Bund—a permanent stretch of standing water. Since in all the previous reports it was found growing in flowing water, the present is a record of a new type of habitat for this alga. In Umed Bund the alga was not growing in equal profusion on all sides of the Bund. Growth was more profuse towards the rocky windward side of the Bund where water-level rises and falls with some force. Towards the side of the Bund, it was less common. However in August 1952, I found this alga near Motikund (Jodhpur). Here it was growing in a temporary stream, a few inches deep, starting from Motikund and ending in Sursagar Tank—a habitat which has been reported previously. In Umed Bund the alga remains only for 20-25 days in the month of August, immediately after rains have set in, but in flowing water it remains longer.

Like the Tirupati material, the well developed thalli of Jodhpur alga are also slightly longer than those described by Iyengar and Agarkar, measuring between 1·3 cm. to 1·5 cm. but in breadth they are like the Gwalior material measuring between 2-3 mm. when mature. Lobed thalli were found to be absent in the Jodhpur material.

In addition to the abovementioned records of this alga, Dr. Dass Gupta of Lucknow has collected it from near Almora. Dr. T. S. Mahabale informs me that he and his students have collected it from Borivli (Bombay).*

I am thankful to Dr. M. O. P. Iyengar for his helpful correspondence and Prof. B. V.

Ratnam for his valuable suggestions and help in preparing this note.

Botany Dept., M. M. BHANDARI.
Jaswant College, Jodhpur,
July 1, 1954.

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* Since this note was sent for publication, the alga has also been collected from still another place in the vicinity of Jodhpur: the Lalsagar—a permanent stretch of standing water. The peculiarity about the alga from here is that the thalli were comparatively bigger and many of them became spherical or globular. Moreover, the labation of the thalli reported by Agarkar has also been found to occur in the Lalsagar meterial.

CHROMOSOME NUMBERS IN INDIAN DESERT PLANTS

WHILE studying the characteristic behaviour of the desert plants, a preliminary study on the cytological aspect was undertaken. The present paper deals with the chromosome numbers of the following plants found in the vicinity of Pilani. A perusal of the literature[1] reveals that no report has been made of the chromosome numbers in these plants so far. The somatic as well as meiotic numbers have been determined from sections and squashes of actively growing root tips and flowerbuds respectively. The chromosome counts are based on maximum numbers counted from intact cells. As recorded in earlier communcations,[2,3] the counts show prevalence of polyploidy and regularity in the chromosomes of Angiosperms.

Plant	Chromosome No.		Basic number of the genus	Uses
	n	2*n*		
Crotolaria burjia Hamilt.	8	16	(8)	Textile fibre
Tephrosia purpurea var. *pumila* Pers.	12	..	(6, 7, 8)	Dye and green manure
Tephrosia purpurea var. *maxima* Pers.	12	..	(6, 7, 8)	Dye and green manure
Indigofera trigonelloides Jaub & Spach.	8	16	(8)	Sand binder
Indigofera cordifolia Heyne	8	16	(8)	Sand binder and medicinal value
Indigofera argentea Linn.	8	16	(8)	Sand binder
Indigofera enneaphylla Linn.	..	16	(8)	Sand binder and Green manure
Indigofera retroflexa ?	..	16	(8)	Green manure
Cassia sophera var. *purpurea* Linn.	12	24	(6, 7, 8)	Horticultural plant

Other desert plants are also being examined from the view-point of chromosome number and morphology. Further studies on the morphology of the different species are in progress and will be published elsewhere.

I am thankful to Dr. B. N. Mulay for kind help during the investigation.

Cytogenetics Lab., K. RAMANATHAN.
Birla College, Pilani,
September 11, 1954.

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MORPHOLOGY OF THE SKULL OF *EUTROPIICHTHYS VACHA*

THERE is not much literature available on the morphology of the skull of Indian siluroid fishes. The pioneer work in the field is that of Bhimachar[1] who worked out the cranial morphology of eight Indian catfishes. The observations on the skull of *Eutropiichthys vacha* have been based on the study of clean and thoroughly bleached skulls.

In the pre-cretaceous bony fishes, Woodward[2] found the posterior cranial region to be flat and also no definite cranial boundary was observed by him. Bhimachar,[1] working on the Indian siluroids, *viz.*, *Wallago* and *Silundia* also observed a flat nature of the hinder region of the skull and associated this condition with primitiveness. On the other hand, in the case of *Eutropiichthys vacha* the occipital region is much ridged and perforated. There is a marked slope visible from the occipital region to the ethmoid region. The supra-occipital spine has also been found to be prominently ridged. The advanced condition of the skull is again evident when the firm articulation of complex anterior vertebra with the skull is taken into consideration. Moreover, the occipital region of the skull is connected by a massive H-shaped post temporal. The basioccipitals are also firmly fused. These skeletal characters take *Eutropiichthys* to a much higher position in the family Siluroidæ.

In addition to the above, there are certain other cranial features of *Eutrophiichthys vacha* which can be traced to the feeding habits of the fish. The thin papery and porous condition of the cranial bones is one outstanding peculiarity associated with such mode of life. If we compare the skull of a sedentary bottom feeding fish like *Clarias batrachus* with that

of *Eutropiichthys vacha*, it is found that the characteristic cephalic shield of the former is entirely absent in the latter, where it would be a sort of hindrance to the attainment of speed. It will not be out of place to mention that the agility of *Eutropiichthys vacha* is further increased due to the porous nature of the upper cranial surface and the thin-ridged occipital region which lightens the weight of the head and thus adds to the buoyancy of the fish. In confirmation of this view it may be noted that parasphenoid has been found to be ill-developed in surface feeding siluroids like *Eutropiichthys* than in the sedentary ones like *Clarias batrachus* and *Saccobranchus fossilis*. The lateral shifted orbits of *Eutropiichthys vacha* can also be correlated with the feeding habit of this fish.

The predaceous nature of the fish has also been responsible for the adaptation of certain characters. In siluroids, usually the premaxilla, dentary and vomer bones are toothed while the maxilla is much reduced and edentulous. But in *Eutropiichthys vacha*, the maxilla is firmly studded with minute conical teeth. This additional dentition is obviously of great help to the fish.

According to Kingsley[2] only one pterygoid bone is found in Siluroids but here an additional metrapterygoid has been observed and unlike the ectopterygoid of *Clarias batrachus* it is very much toothed. The articular bone has also been found to be provided with small teeth on its surface.

The skull of *Eutropiichthys vacha* thus clearly shows both advanced characters as well as the characters which the fish has adapted for its mode of life.

The author's grateful thanks are due to Dr. D. R. Bhattacharya for his kind interest in the problem and to Dr. S. K. Dutta for the encouragement and guidance.

Zoology Dept., ANJNI KUMAR.
C. M. P. Degree College,
Allahabad, *September* 27, 1954.

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PHYLOGENETIC STUDY OF THE FAMILY CHRYSOMELIDÆ COLEOPTERA

MALE and female genital conduits of 90 species representing thirteen subfamilies of Chrysomelidæ known to occur in India were studied by the author while determining the inter-subfamily relationship.

Taking subfamily Orsodacninæ as the most primitive (Sharp and Muir[1]), the subfamily Donaciinæ follows Orsodacninæ closely by virtue of strongly keeled cap piece and completely ringed character of tegmen in the male genital tube. The subfamilies Sagrinæ and Criocerinæ are closely related for reasons such as, strongly keeled and partially ringed character of tegmen in male genital tube, and closely attached paraproct—proctiger and valvifer—coxite condition in female genitalia. These characters being common to the subfamily Donaciinæ save partially ringed condition of tegmen, a positive relationship between this subfamily and the former two can be assumed.

The subfamilies Clytrinæ and Cryptocephalinæ are closely associated; characters common to both are—short and stout median lobe, broad and long median foramen, internal sac with typical elongated chitinized sclerites, and compact spiculum gastrale with stout arms in male genital tube while in female genitalia dorso-lateral position of proctiger which joins with coxite through a valvifer. Absence of sclerotized rod in coxite are common.

These two subfamilies show marked affinity with the preceding subfamilies in respect to keeled condition of tegmen in the male genital tube. The short and stout median lobe in male genital tube and bilobed appearance of coxite in female genitalia links the subfamily Chlamydinæ with the subfamilies Clytrinæ and Cryptocephalinæ. The subfamilies Lamprosominæ and Eumolpinæ exhibit close relationship due to the presence of shield like tegmen, long median foramen, sometimes half of median lobe in male genital tube and telescopic condition of female genitalia. The latter subfamily also maintains relationship with the subfamily Galerucinæ. The common characters in the female genitalia are: long forked appearance of valvifer and presence of long thin sclerotized rod supporting the coxite. The subfamilies Galerucinæ and Alticinæ are very closely related due to the presence of tube-like median lobe, modified rod like Y- or V-shaped tegmen in male genital tube and loose attachment of valvifer with coxite in female genitalia.

Marked affinity between Cassidinæ and Hispinæ is established by the presence of partially ringed and keeled condition of tegmen, elbowed appearance of median lobe at the junction of median foramen in male genital tube and close attachment between proctiger-coxite and

TABLE I

Table giving salient characters of genitalia in the different subfamilies of Chrysomelidæ

Name of Subfamily	Characters of genitalia	
	Male	Female
Donaciinæ ..	Tegmen completely ringed, round median lobe and cap piece strongly keeled	Valvifer-coxite closely attached
Sagrinæ and Criocerinæ ..	Tegmen partially ringed, round median lobe and cap piece strongly keeled	Paraproct-proctiger and valvifer-coxite closely attached
Clytrinæ and Cryptocephalinæ ..	Median lobe short, stout, median foramen long, internal sac with typical elongated chitinized sclerites and spiculum gastrale compact with stout arms	Proctiger dorso-laterally placed and joined with coxite through valvifer, sclerotized rod in coxite wanting
Chlamydinæ ..	Median lobe short and stout	Coxite bilobed
Lamprosominæ and Eumolpinæ ..	Tegmen shield like, median foramen long sometimes half of median lobe	Female genital segments telescoped within each other
Chrysomelinæ ..	Tegmen mildly keeled, arms incompletely embracing median lobe	Proctiger-coxite closely connected valvifer wanting
Galerucinæ and Alticinæ ..	Median lobe tube like, tegmen modified into Y-or V-shaped, rod like structures	Valvifer-coxite loosely attached
Cassidinæ and Hispinæ ..	Tegmen partially ringed round median lobe and keeled, median lobe elbowed.	Proctiger-coxite closely attached, valvifer wanting

absence of valvifer in female genitalia. None of the characters either in the subfamily Hispinæ or Cassidinæ are common to Eumolpinæ as stated by Powell.[2] Their affinity with the subfamily Chrysomelinæ is more conspicuous by similarity of characters like tegmen being mildly keeled and arms incompletely embracing the median lobe in male genital tube and close connection between proctiger-coxite and absence of valvifer in female genitalia. Through the subfamily Chrysomelinæ subfamilies Hispinæ and Cassidinæ may also be related to subfamilies Clytrinæ and Cryptocephalinæ on the basis of keeled condition of tegmen in the male genital tube.

As a result of this study, it can be concluded that the subfamilies Donaciinæ, Sagrinæ and Criocerinæ are the most primitive, followed by Clytrinæ and Cryptocephalinæ, while Galerucinæ and Alticinæ are more recently evolved.

Thanks are due to Dr. K. B. Lal, under whose personal guidance the work was carried out, and to Indian Council of Agricultural Research for the award of Fellowship.

Lab. of the Entomologist to Govt. of U.P.,
Kanpur, *July* 31, 1954. B. K. VARMA.

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EFFECT OF IRON ON HEADING OF WHEAT

EXPERIMENTS were conducted during 1950-53 to study the effect of iron on the heading of wheat (Pb 591). The interval for initial presence and absence of iron was kept for 40 days with a total life-cycle of 120 days in the first year, but in the second and third years the interval was made 20 days with a total life-cycle of 100 days and 120 days respectively. Plants were cultured in pyrex containers supplying nutrients following Knop's[3] modified schedule except for the quantity of iron (Ferric tartrate) which was supplied according to the plan of the experiments. Table I indicates the time interval from planting to heading stage.

The results from Table I show that the plants receiving no iron did not bear heads because of their premature death. On an average it took 4-5 days from 'A' to 'E' stage. Appearance of heads late in 1950-51 is explained by the fact that the experiment was started much earlier in the season which increased the life-cycle of plants. It was noticed that the presence of iron upto the first 40 days did not produce ears and if this period was extended to 60 days and onwards emergence was hastened by 3-5 days, but this was true upto 80 days only, after which it had, if at all, very little

TABLE I

Effect of initial supply of iron followed by its absence on heading in wheat

Initial supply of iron in days	1950–51				1951–52				1952–53			
	Fe_1		Fe_2		$Fe_{1/2}$		Fe_1		$Fe_{1/4}$		$Fe_{1/2}$	
	Age in days				Age in days				Age in days			
	A	E	A	E	A	E	A	E	A	E	A	E
0	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
20	..	..	..	..	NE	NE	NE	NE	NE	NE	NE	NE
40	NE*	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
60	..	..	..	..	85·75	91·25	87·25	93·35	88·35	93·75	88·38	93·69
80	102·12	107·75	103·37	107·12	83·75	88·95	83·34	88·62	84·32	88·43	84·47	89·13
100	..	..	..	..	82·75	87·75	83·20	87·81	83·65	87·96	84·21	88·92
120	100·85	105·12	101·55	106·12	..	..	..	..	83·65	87·96	84·21	88·93

* NE = No Emergence.

Fe_1 = 12·91, Fe_2 = 25·82, $Fe_{1/2}$ = 6·45, $Fe_{1/4}$ = 3·22—in p.p.m.

effect. This may be explained by the fact that the emergence took place just after 80 days. Thus it is indicated that the presence of iron between 40 and 80 days and especially between 60 and 80 days was essential. This fact was emphasised by Gericke[2] working on wheat who showed that if the iron supply was stopped after 6 weeks plants died of premature death and if it was withheld after 8-10 weeks it resulted in inhibited grain production. It is further indicated that the concentrations higher than $Fe_{\frac{1}{4}}$ (3·22 p.p.m.) had no better effect. Aiyer[1] working on rice has stressed that the quantity of iron required each time by rice plants is too small, and a concentration lower than 2·0 p.p.m. showed symptoms of deficiency.

It was also observed that the initial deprivation of iron for the first 40 days delayed the emergence by 2 days and increasing the deprivation beyond 60 days plants did not bear heads.

The author is indebted to Dr. N. K. Anant Rao, for his valuable guidance and suggestions.

Agronomy Section, R. M. SINGH.
B. R. College, Agra,
September 17, 1954.

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A BACTERIAL LEAF-SPOT DISEASE OF *LOCHNERA PUSILLA*

Lochnera pusilla K. Schum., a common weed in the cultivated fields was found to be heavily infected with a bacterial disease in the neighbourhood of Pimpri and Agricultural College Farm, Poona. On isolation by usual poured plate method, small, deep yellow pathogenic colonies appeared after 48 hours at 30° C. which when studied for morphological, cultural and biochemical characters was found to be a species of *Xanthomonas*. Artificial inoculation of healthy plants by spraying the water suspension of pure culture of the bacterium gave disease symptoms within eight days.

The pathogen incites three types of symptoms on the host: (*i*) A ring formation is seen when water-soaked areas with brown centre and pale yellow halo form a deep brown coloured periphery around each spot measuring 1-2 mm.; (*ii*) Sometimes, the brown centre of the water-soaked areas goes on increasing so rapidly that the yellow halo around each such spot is not able to keep pace with the increase in the size of deep brown spots and ultimately, only deep brown spots measuring 1-2 mm. are seen; and (*iii*) In advanced stages of heavy infection, the leaves become yellow and readily get detached from the plants. The infection spots increase in size to about 3-4 mm. leaving a parchy centre and deep brown periphery around them. The pathogen infects cotyledons and pods

besides leaves. The technical description of the pathogen is as follows :

Short rods ; single polar flagellum ; gram negative ; capsulated ; non-spore former ; agar colonies circular with entire margin, smooth, butyrous, raised and barium yellow, measuring 20 mm. after 8 days on potato dextrose; gelatin liquefied ; starch hydrolysed ; casein digested ; hydrogen sulphide and ammonia produced from peptone ; indol not produced ; milk peptonised and litmus reduced ; good growth in synthetic nitrate and Czapek's media ; nitrite and ammonia not produced from nitrate ; acid without gas from arabinose, dextrose, lactose, sucrose and starch ; no growth in salicin ; optimum temperature for growth 27-30° C.; thermal death point about 51° C.

From the morphological, cultural and biochemical responses, it is difficult to distinguish the *Xanthomonas* species under study from other *Xanthomonas* species. When host range of related and unrelated plants was tried it was observed that the pathogen is specific to *L. pusilla* only. Since there is no record of a *Xanthomonas* species on Apocynaceæ and as the pathogen is highly specific to its suscept, it is proposed to designate it a new species *Xanthomonas lochnerœ*.

Fuller details will be published elsewhere.

M. K. Patel.
M. J. Thirumalachar.
V. V. Bhatt.

Plant Pathological Lab.,
College of Agriculture,
Poona-5, *October* 7, 1954.

A NEW METHOD FOR THE STUDY OF CERCARIÆ

The cercariæ are usually studied alive either stained with vital dyes or unstained, the normal methods of fixing and subsequent staining being rather unsatisfactory. All these methods were disappointing with the amphistome cercariæ of the Pigmentata group. The presence of a large amount of dark brown pigment and cystogenous cells prevented the study of the internal organs, particularly the rudiments of the genital system when the cercariæ are studied alive. The brown pigment can of course be bleached, but even then the cystogenous cells interfere with staining. While the author was studying the life-history of an amphistome of cattle, a method was evolved which makes the study of internal organs possible. A drop of aceto-carmine (45 per cent. glacial acetic acid boiled with excess of carmine and filtered) is placed on a slide on which live cercariæ are transferred and manipulated with steel needles to add the necessary amount of iron. After about 2 minutes a No. 0 cover glass is placed on the drop and the preparation is ready for examination. The aceto-carmine kills the cercariæ in relaxed condition, dissolves the brown pigment, the cystogenous cells and the excretory granules, and at the same time fixes and stains the various organs. If necessary, the excess of stain can be washed with a drop of acetic acid (45 per cent. glacial). But it was found that permanent preparations are unsatisfactory. The author has used this method for a number of years with amphistome and other types of cercariæ with great success.

Dept. of Zoology, Kunwar Suresh Singh.
The University,
Lucknow, *October* 27, 1954.

UTILIZATION OF NATURAL BYPRODUCTS FOR THE CULTIVATION OF BLUE-GREEN ALGAE

The work of Allen,[1] Gross[2] and Harvey[3] has proved the importance of trace elements as essential auxiliaries of the major nutrients, Ca, K, Mg, Na, Cl, S, P and N in the metabolism of planktonic organisms including diatoms. In their studies extracts of *Ulva* and *Fucus*, unsuspected as sources of trace elements, were actually found to induce the growth in cultures of diatoms in artificial sea-water. It has been shown elsewhere[4] that the maximum growth of blue-green algæ of salt water lagoons is dependent upon definite proportions of trace elements Mn, B, Cu, I, Fe, etc., besides those of the major nutrients mentiond above and that the soluble extracts from the sea-weeds are rich in these trace elements. The information is no doubt helpful, yet the addition of chemicals to increase the plankton would be costly and at present of little practical value in India. Cheap fertilizers and byproducts will have to be explored for this purpose. The present communication deals with the attempts made to utilize oilcakes, sea-weed composts and the wastes in the industries involving sea-weeds of high trace element content as possible sources as fertilizers for the production of fish food.

The artificial sea-water media were prepared according to the formula given by Lyman and Fleming.[5] The cold water-soluble portions of two oilcakes, *viz.*, gingelly oilcake and groundnut oilcake, were used in one series, that of

TABLE I

Trace element content of the substances used in cultures

(Expressed as mg. per kg. of dry material)

Material used	Mn		B		Cu		I		Mo		Fe	
	Total	W.S.	Total	W.S.	Total	W.S.	Total	W.S.	Total	W.S.	Total	W.S.
Oilcakes:												
Gingelly oil cake	74	..	nil	..	..	..	nil	..	..	..	32	..
Groundnut oilcake	16	..	nil	..	..	..	nil	..	..	..	25	..
Sea-weed composts:												
Hypnea + cow dung	105	28	5·8	1·2	trace	nil	18	trace	0·10	trace	102	14
Hypnea + fish waste + cow dung	84	26	4·2	0·9	trace	nil	28	trace	0·10	trace	84	12
Sargassum + cow dung	44	15	2·8	trace	2·1	nil	100	18	..	nil	60	8
Sea-weeds:												
G. lichenoides	350	160	12·8	2·0	10·0	3·0	119	20	0·24	0·08	70	12
C. dasyphylla	155	50	8·5	1·0	6·0	1·8	90	12	0·10	0·05	186	32
L. papillosa	240	100	4·4	0·4	3·8	1·2	trace	trace	0·05	trace	140	40
H. musciformis	195	95	7·5	1·0	nil	nil	trace	trace	0·09	trace	172	35

three sea-weed composts (*Hypnea* + cow dung; *Hypnea* + fish waste + cow dung and *Sargassum* + cow dung) in another and that of four species of sea-weeds, viz., *Gracilaria lichenoides*, *Chondria dasyphylla*, *Laurencia papillosa* and *Hypnea musciformis* in a third series.

The quantity of the various trace elements present in the water-soluble portions of the above was determined by analysing separately the extracts prepared from 5-10 g. of the samples. The total trace element content and the amounts in the water-soluble portions are tabulated in Table I.

To 10 ml. of the media in petri dishes were added 1, 2 and 3 ml. of the sterilized extracts separately. To these dishes equal quantities of an algal association (5 mg.) from a stock culture were inoculated. The composition of the algal association was as follows:

Phormidium tenue (Menegh.) Gom.—dominant.

Phormidium ambiguum Gom.—common.

Microcoleus chthonoplastes Thuret.—common.

Nitzschia vitrea Norman.—sub-dominant.

Nitzschia seriata—rare.

Gloeocapsa arenaria (Hass.) Rabh. (also its nannocyst stage)—few

Gymnodinium sp. (Dinoflagellate)—rare.

The growth obtained in the controls and in the treatment vessels after one month was estimated separately and the results are tabulated in Table II.

It may be seen from Table I that in the case of almost all the trace elements nearly 30 per cent. are present in a water-soluble form, and that all the algæ screened are sufficiently rich in trace elements except *L. papillosa*. Table II affords evidence of good growth of algæ in the treatment vessels, especially those treated with

TABLE II

*Weight of algæ obtained from different treatment vessels**

Source of trace elements	Control	1 ml. of extract		2 mls. of extract		3 mls. of extract	
	Wt. in g.	Wt. in g.	Chlorophyll	Wt. in g.	Chlorophyll	Wt. in g.	Chlorophyll
Hypnea + cow dung	nil	0·015	25	0·042	85	0·060	120
Hypnea + cow dung + fish waste	nil	0·015	30	0·040	85	0·052	105
Sargassum + cow-dung	nil	0·012	20	0·024	50	0·040	95
Gingelly oilcake	..	0·009	..	0·012	25	0·018	40
Groundnut oilcake	..	0·006	..	0·010	..	0·012	30
G lichen ides	0·008	0·023	40	0·045	95	0·076	185
C. dasyphylla	0·007	0·032	65	0·048	95	0·083	200
L. papillosa	nil	0·015	20	0·029	65	0·056	95
H. musciformis	0·008	0·020	40	0·040	90	0·073	150

* Average from three series of trials.

the extracts from *G. lichenoides*, *C. dasyphylla* and *H. musciformis*. There was similarity in the cultures in species composition. The extracts from the two oilcakes do not seem to favour the growth of the algæ to any appreciable extent. This may be because of the absence of several of the essential trace elements in them as may be seen from Table I.

My grateful thanks are due to Dr. N. K. Panikkar, for his keen interest in the work and to Dr. (Mrs.) F. Thivy for the identification of the algæ.

Central Marine Fisheries Res. Station, Mandapam Camp, *October* 25, 1954.

V. KRISHNA PILLAI.

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NEUROSECRETORY CELLS IN *PARATELPHUSA HYDRODROMOUS* (HERBST)

NEUROSECRETORY cells, *i.e.*, neurones with pronounced glandular activity have recently been discovered in some Decapod Crustacea (Enami,[1] Bliss and Welsh,[2] Knowles,[3] Bliss, Durand and Welsh[4] and Matsumoto[5]). They are described to be endocrine centres in the central nervous system. Their physiological activity has been studied by Bliss[6] in *Gecarcinus*, Knowles[3] in *Leander*, Carlisle and Dohrn[7] in *Lysmata* and Enami[8] in *Sesarma*.

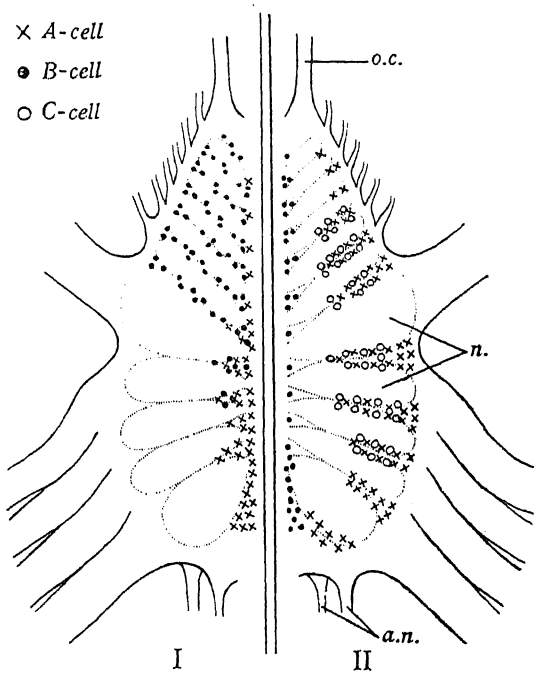


FIG. 1. Diagram to illustrate the distribution of the neurosecretory cells in the thoracic ganglion of *Paratelphusa hydrodromous*. (*i*) Dorsal view, (*ii*) Ventral view. The position of the C-cells is illustrated only in (*ii*), but these cells do not occur at the surface. *o.c.*, œsophageal commissure; *n.*, neuropiles; *a.n.*, Abdominal nerves.

A study of the distribution and structure of the neurosecretory cells in the central nervous system of the common fresh-water crab, *Paratelphusa hydrodromous* (Crustacea, Brachyura) was recently started in this Department. The central nervous system of this crab contains three types of neurosecretory cells, designated A, B and C, distinguished by their size, cytoplasmic contents and nature of vacuoles. All these types occur in the thoracic ganglion while the brain and the tritocerebral connective ganglia contain only the A and B types. The distribution of these cells in the thoracic ganglion is given in Fig. 1. Of the three types the A cells are the most conspicuous (Fig. 2). They



FIG. 2. Giant neurosecretory cells (A-type) showing the minute dark cytoplasmic granules and axons. Photomicrograph, ×300. Fixation, Susa; Mallory's triple stain.

are giant cells corresponding to the A cells of *Eriocheir* (Matsumoto[5]) but much larger. They measure about 150-60 μ in diameter. Under the phase-contrast microscope, their live cytoplasm shows myriads of tiny granules appearing greyish and a large number of tiny sphere-like bodies somewhat variable in size and appearing black. These granules and spheroids are traceable along the axons. The nucleus is large and rounded with a large nucleolus, the darker bodies of the chromocentres scattered here and there and minute granules. In addition, the

cytoplasm possesses a number of vacuoles which are different from the spheroids and larger in size. The spheroids of the cytoplasm show up in Aoyama preparations and Baker's Sudan-black technique as excellent black rings showing the deposit of argentophil and Sudanophil structure on their walls. In fixed preparations, a number of small vacuoles are seen, some of which are traceable along the axons as well. The height of secretory activity is indicated by large vacuoles all along the periphery of the cell. Another important aspect noticed is the relative abundance of the secretory materials in gravid and ovigerous females and the presence of a large number of peripheral vacuoles. The secretory products are stained dark blue in Gomori's chrome-hæmatoxylin-phloxin and bright red in Heidenhain's Azan.

Further details will be published elsewhere.

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SOME PECULIARITIES OF THE STRUCTURE OF THE CUTICLE OF SOME INDIAN SCORPIONS

In a former paper the author[6] described the occurrence of the openings of the dermal glands in the cuticle of *Palamnœus bengalensis* and *Buthus tamulus gangeticus*.

The presence of the outermost layer, namely, an epicuticle in the cuticle of some arthropods as reported by Langner[1] for the Diplopoda and Cloudsley-Thompson[2] for the Myriapoda has been questioned by Blower[1] who considered that the appearance of this layer was merely a diffraction effect. Krishnan[3] claimed a very thin epicuticle bounded externally by a still thinner membrane in *Palamnœus swammerdami* which he demonstrated as staining blue with Mallory and hæmatoxylin. During the course of an investigation on the cuticle of scorpions at Lucknow the writer did not notice the presence of any thinner membrane bounding the epicuticle externally which will stain blue with Mallory or hæmatoxylin. The epicuticle in *Palamnœus bengalensis* and *Buthus tamulus gangeticus* however is very thick in contrast to a thin and flimsy epicuticle of *Palamnœus swammerdami*. It appears light greenish yellow in colour and takes no stain either with Mallory or hæmatoxylin. It is as usual further distinguished from the rest of the cuticle by being non-chitinous. It is also double-layered, an outer dried varnish like very resistant epicuticle consisting of bound lipoids in it which are liberated as oil droplets on heating with concentrated chlorated nitric acid and an inner layer which is not so resistant and dissolves without heating in concentrated chlorated nitric acid in few minutes or in about 2 hours in concentrated nitric acid alone leaving vertical striations referred to latter. The inner layer in contrast to the outer layer stains intensely with Sudan IV. In *Buthus tamulus gangeticus* however the comparatively thicker epicuticle layer has its outer surface very uneven and produced into denticular projections all over.

Further the exocuticle in *Buthus tamulus gangeticus* is very thin but is very well developed in *Palamnœus bengalensis* and *Palamnœus swammerdami*. Krishnan[3] describes that in *Palamnœus swammerdami* the endocuticle stains blue with Mallory and the exocuticle red. The exocuticle shows some loss of affinity to the stains with the resumption of an amber colour. There is also an indication of inpushing of the red staining zone. In *Palamnœus bengalensis* as well as in *Buthus tamulus gangeticus*, however, the amber coloured material is more or less feebly though not uniformly dispersed in the endocuticle. The endocuticle stains red with Mallory rather feebly while the exocuticle does not stain at all. This shows that the cuticle of *Palamnœus bengalensis* and of *Buthus tamulus gangeticus* is more advanced so far as the process of hardening and sclerotization is concerned.

Another peculiar feature about the cuticle of *Palamnœus bengalensis* and *Buthus tamulus gangeticus* is that very well developed helical pore canals as reported in the pronotum of cockroach by Richard and Anderson[5] are found to densely pack and pierce the cuticle from below upto inner boundary of the epicuticle. These are referred by Krishnan[3] as vertical striations in the cuticle of *Palamnœus swammerdami*. In *Palamnœus bengalensis* as well as *Buthus tamulus gangeticus* these do not take a straight course but run in a spiral fashion (Figs. 1 and 2). This character of the pore canals finds best expression in the well

developed exocuticle of the former where prominent spirals of greater diameter and pitch can be seen very clearly in fresh sections treated with Millon's reagent for about 4 hours. In *Buthus tamulus gangeticus* these end in peculiar funnel-shaped dilations (Fig. 2) beneath the epicuti-

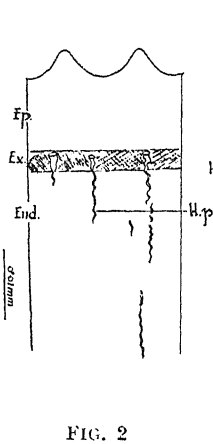


FIG. 2

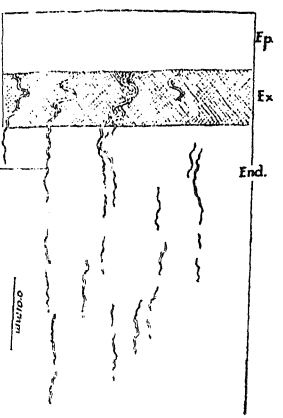


FIG. 1

FIG. 1. T.S. of the cuticle of *Palaemonus bengalensis*. FIG. 2. T.S. of the cuticle of *Buthus tamulus gangeticus*. *Ep.*—Epicuticle, *Ex.*—Exocuticle, *End.*—Endocuticle, *H.p.c.*—Helical pore canal.

cle. That these canals are not merely solid rods but contain cytoplasmic filaments is shown by their getting stained with Delafield and Heidenhain hæmatoxylin. These canals appear distinctly brown in the exocuticular region and also reduce ammoniacal silver nitrate. These do not seem to extend beyond exocuticle but in transverse sections which were left for about 2 hours in concentrated nitric acid or for a few minutes in concentrated chlorated nitric acid vertical striations are seen in the inner epicuticle. Further work is in progress.

The writer is thankful to Prof. M. B. Lal for guidance and to the Scientific Research Committee, Uttar Pradesh, for providing funds to carry out the work.

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OCCURRENCE OF LYCORINE IN THE BULBS OF *CRINUM LATIFOLIUM* LINN.

THE occurrence of lycorine in the bulbs of *C. defixum* and its isolation from this source have been reported in a recent communication from these laboratories.[1] Examination of the bulbs of *C. latifolium* Linn. along similar lines has revealed that the same alkaloid is present in this species also and indeed to a slightly greater extent than in *C. defixum* (0·07 per cent. in *C. latifolium* as against 0·053 per cent. in *C. defixum*). The isolation was achieved in the following manner: The minced bulbs of *C. latifolium*, after fermentation in a nitrogen atmosphere at room temperature, were extracted with alcohol. The alcoholic extract was partially concentrated, shaken with lead hydroxide and filtered. The filtrate, after adjustment of the reaction to pH 6 and further concentration, was extracted with petroleum ether and ether in succession. After elimination of all alcohol from the residual aqueous alcoholic extract by evaporation under reduced pressure, it was further extracted with chloroform and chloroform-alcohol (2 : 1). Lycorine could be obtained by direct crystallisation from the residues representing the ether-extract, the chloroform-extract and the chloroform-alcohol-(2 : 1) extract. The main aqueous solution was rendered alkaline with solid potassium carbonate and extracted again with chloroform and chloroform-alcohol (2 : 1). From this chloroform-extract also lycorine was obtained by direct crystallisation.

The identity of the alkaloid was established by the following properties: m.p. 272-74° (decomp.), $[\alpha]_D^{30} = -96{\cdot}2° \pm 3°$ in absolute alcohol. Its analysis agreed with the formula $C_{16}H_{17}O_4N$. The acetate prepared using acetic anhydride and pyridine melted at 218-20° C, had $[\alpha]_D^{30} = +21{\cdot}8° \pm 4°$ in chloroform, and analysed for the formula $C_{20}H_{21}O_6N$. The mixed melting point of this acetate with lycorine acetate obtained from *C. defixum*[1] was undepressed. Further details will be published elsewhere.

We thank Dr. B. N. Mulay of Birla College, Pilani, for the supply of authentic plant material.

Dept. of Pharmacy, S. RANGASWAMI.
Andhra University, E. VENKATA RAO.
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CHAIN-TRANSFER IN THE BENZOYL PEROXIDE CATALYSED POLYMERISATION OF STYRENE IN VARIOUS SOLVENTS

SCHULZ AND HUSEMANN[1] have shown that the initial rate of polymerisation in the benzoyl peroxide catalysed polymerisation of styrene in toluene is accurately represented by the law:

$$-\frac{dM}{dt} = k_0 B^{1/2} M^{3/2} \qquad (1)$$

Josefowitz and Mark[2] have also shown that the initial rate varies with monomer concentration according to the following equation:

$$-\frac{dM}{dt} = k \cdot \frac{B^{1/2} M^{3/2}}{[1+K(M)]^{1/2}} \qquad (2)$$

The above expressions are based on a bimolecular initiation reaction. The following equation has been derived between the reciprocal of the degree of polymerisation $(1/\bar{P})$ and the chain-transfer constant (C):

$$\frac{1}{\bar{p}} = \frac{(k_i k_t)^{1/2} B^{1/2}}{k_p M^{1/2}} + \frac{k_{tr}}{k_p} + C \cdot \frac{S}{M} \qquad (3)$$

This relationship has been made use of in evaluating the method of the determination of chain-transfer constants of styrene in four hydrocarbons in presence of small quantities of benzoyl peroxide as catalyst at 60 and 80° C.

In our studies we have shown that the transfer constants (C), calculated from the slope of $1/\bar{P}$ against S/M plots at constant values of $(B/M)^{\frac{1}{2}}$ are not appreciably affected by the presence of low concentrations of benzoyl peroxide. This is illustrated in Fig. 1, for the set of determinations at 60° C. The values of chain-transfer constants at 60° as determined from these plots have been found to be 0·23, 0·31, 1·21 and 7·00 for benzene, cyclohexane, toluene and ethyl benzene respectively. These values as determined by Gregg and Mayo[3] for the uncatalysed polymerisation of styrene in the above solvents are 0·18, 0·24, 1·25 and 6·7 respectively.

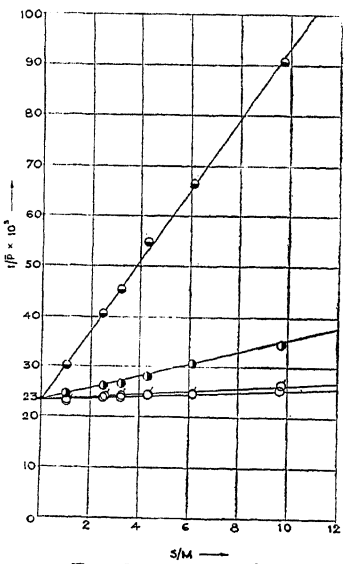


FIG. 1. Temp. 60° C.
Value of $(B/M)^{1/2}$ $22{\cdot}72 \times 10^{-3}$
○ Benzene; ♂ Cyclohexane; ◑ Toluene; ◒ Ethyl benzene

It is found that the plots of $1/\bar{P}$ against S/M values for the four different hydrocarbons all give the same intercept on the $1/\bar{P}$ axis when $(B/M)^{\frac{1}{2}}$ is kept the same for the different sets of solvents. This is in agreement with the observations of Gregg and Mayo[3] for the uncatalysed polymerisation of styrene in these solvents.

Similar results have been obtained for the polymerisations at 80° C. The study of chain-transfer of styrene with various halogenated hydrocarbon solvents is in progress and the detailed paper will be published elsewhere in due course.

The best thanks of the authors are due to Prof. A. C. Chatterji for facilities, and to the Scientific Research Grants Committee, U.P., for a fellowship to R. N. C.

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Lucknow University, G. S. MISRA.
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LIFE-HISTORY OF *COLDENIA PROCUMBENS* LINN.

THE anther, in its structure, shows epidermis, two wall-layers, secretory type of anther tapetum of parietal origin surrounding the sporogenous tissue. The tapetal cells are two-nucleate. The division of the pollen mother-cells is simultaneous. Cytokinesis takes place by furrowing. Both tetrahedral and bilateral tetrads are found. Pollen grains are two-nucleate at the time of shedding. They show three germ pores in the exine. In a few flowers the corolla did not drop off but persisted in a shrivelled up condition enclosing the anthers. Many of the pollen grains contained within the anther lobes of these flowers germinated *in situ*.

The ovule is hemianatropous, unitegmic and tenuinucellate. The innermost layer of cells of the integument forms the endothelium. Unlike sympetalæ in general, here the primary archesporial cell undergoes a mitotic division resulting in the formation of an upper primary parietal and a lower primary sporogenous cell (Fig. 1). In this feature *Coldenia procumbens* departs from most sympetalæ and adds to the list of exceptional sympetalæ such as Plumbaginaceæ (Maheshwari[1]), *Convolvulus arvensis* (Mathur[2]), *Ipomea learii* (Raghava Rao[3]), in which also the formation of a parietal cell has been recorded previously.

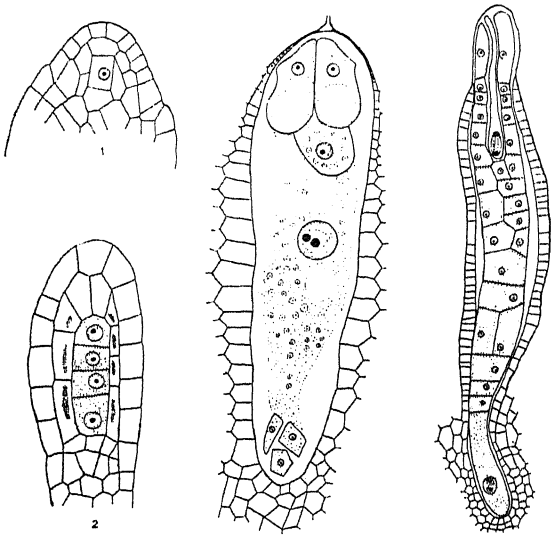


FIG. 1. L.S. of an ovule showing megaspore mother cell, × 725. FIG. 2. L.S. of upper part of ovule showing a linear tetrad of megaspores, × 725. FIG. 3. L.S. of ovule showing an embryo-sac, × 485. FIG. 4. L.S. of ovule showing the endosperm with micropylar and chalazal haustoria, × 480.

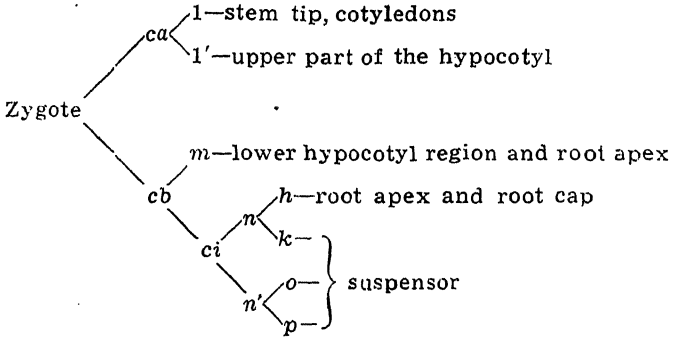
Usually the archesporium is one-celled. A linear tetrad is formed (Fig. 2) and the chalazal megaspore of the tetrad is functional. An eight-nucleate embryo sac is developed according to the Polygonum type. The synergids are hooked. Antipodals disappear just before fertilisation. The egg and the embryo sac contain starch grains (Fig. 3).

Fertilisation is porogamous. Endosperm is of cellular type. The first division of the primary endosperm nucleus divides the embryo sac into a micropylar and a chalazal chamber. The micropylar chamber divides transversely and forms two chambers one above the other. The upper containing the fertilised egg undergoes two vertical divisions at right angles to one another and results in four cells. These elongate and form the micropylar haustorium while the chalazal chamber becomes two-nucleate due to a nuclear division in it. Eventually, however, the two nuclei fuse and this binucleate cell functions as the chalazal haustorium. The middle cell divides many times, each division being followed by the formation of a cell-wall. Thus a mass of cellular tissue is produced, forming the bulk of the endosperm. The endosperm shows three regions, namely, the micropylar haustorium, cellular endosperm tissue and the one-celled binucleate chalazal haustorium.

The embryo development has been studied in detail. The first division of the zygote takes place after the micropylar and chalazal haustoria are fully differentiated and the cellular endosperm tissue is well developed in the central chamber (Fig. 4). The development of the embryo is schematically represented below and it conforms to the Chenopodiad type.

Dept. of Botany, J. VENKATESWARLU.
Andhra University, B. ATCHUTARAMAMURTI.
Waltair, *August* 31, 1954.

1. Maheshwari, P., *An Introduction to the Embryology of Angiosperms*, 1950, McGraw-Hill Book Co., N.Y.
2. Mathur, K. L., *Curr. Sci.*, 1934, **3**, 160-61.
3. Raghava Rao and Rao, K. V., *J. Indian Bot. Soc.*, 1940, **19**, 53-69.



REVIEWS

Acoustics. By Dr. Leo L. Beranek. (McGraw-Hill), 1954. Pp. x + 484. Price $ 9.00.

In the twelve years that have elapsed since the first edition of Prof. Philip Morse's book, *Vibration and Sound*, appeared, there has been no rival to it as a text-book for Degree courses in colleges and universities. Prof. Beranek's new book, *Acoustics*, is a strong contender for the same honour.

Beranek needs no introduction to students and research workers in acoustics. For more than a decade, he has published, sometimes singly, often in collaboration, a good many papers on a variety of topics and his first book, *Acoustical Measurements*, published five years back, is almost a classic. The book under review has grown naturally out of the courses. Beranek has conducted at the M.I.T. and Harvard in recent years.

The volume has been written frankly as a text-book and is indeed, a boon to the college instructor. The subject-matter is so arranged that the lecturer's task is made easy by maintaining a balance between theory and experimental results. The author has thoughtfully included suggestions for instructors giving a rough division of the course in acoustics. The worked-out examples at the end of every topic and the set of graded problems for every chapter add to its value as a text-book. However, the volume is more than a mere text-book. There is a wealth of experimental data in the collection of which the author himself has taken a leading part. There are also copious references to the latest research papers on the subject. However, the addition of a chapter on recording and a discussion of room acoustics and recent experimental techniques like the pulse technique would have enhanced its value as a text-book.

The get-up is pleasing and the book is free from typographical errors, which is indeed remarkable, considering the wealth of symbols and formulæ scattered on every page.

Some might regard the price as a little high, but Dr. Beranek's book gives more for nine dollars than many others in the market, on the same subject.

RAM K. VEPA.

The Amplification and Distribution of Sound. Third Edition. By A. E. Greenless. (Chapman & Hall), 1954. Pp. 300. Price 35 *sh.*

This is a general text on the subject of what is often called by the less descriptive terminology, "Public Address Systems". In spite of the fact that amplified sound is encountered in daily life, there are not many books which give an integrated account of the various components that make up a public address system.

The present work is addressed primarily to one concerned with the choice and installation of the sound system with the object of enabling him to appreciate the fundamental principles involved. There are eighteen chapters of which the first eight are devoted to a discussion of the usual types of audio amplifiers, their power supplies and the electrical components used in them. The next three chapters on electroacoustic transducers describe the principles involved in the construction of the more common types of microphones, loudspeakers and gramophone pick-ups and their properties like frequency response, sensitivity, directional characteristics, etc. The remaining seven chapters discuss the considerations involved in the planning, lay-out and maintenance of public address systems in auditoria, cinema theatres, open air, etc.

The author's attempt to bring together in this book a number of facts about several different units that comprise a sound system is commendable. The treatment, however, is for the most part, introductory rather than detailed, and, where it concerns the fundamentals, is occasionally even unsatisfactory, as for instance when the author introduces Ohm's Law (p. 6). The scanty four pages on optical and magnetic recording do not add to the reader's knowledge on these matters. Likewise, stereophonic sound systems which are fast coming into commercial use are dispensed with in one page.

The reviewer likes to stress again that although there is enough justification for the publication of this book for reasons mentioned earlier, the cost (35 *sh.*) is very much on the high side.

B. S. RAMAKRISHNA.

Stainless Iron and Steel, Vol. II. (*Microstructure and Constitution.*) By J. H. G. Monypenny. (Chapman & Hall), 1954. Pp. 330. Price 55 *sh.*

The volume under review has been ably edited by Prof. F. C. Thompson from the rough manuscripts and notes of illustrations prepared by the author before his death.

Chapter 1 deals with the structure and constitution of iron-chromium alloys with and without carbon. The author points out the difficulty due to hysteresis in determining the boundaries of the sigma phase in the temperature range of 780-810° C. He also discusses the influence of chromium on the sluggishness of carbide dissolution and the hardening response of such steels.

Chapter 2 describes the embrittlement of high chromium steels by prolonged heating at 400-500° C. and emphasizes that the evidence of the iron-chromium compound as the embrittling agent is, so far, only indirect. Recent work at the Kearny Laboratory in U.S.A. published after this book, indicates it to be a chromium-iron phase considerably richer than sigma in chromium and of a different crystallographic system. The particles can, however, be only detected with a new electron microscope technique.

In Chapter 3, the effects of nickel on chromium steels are discussed. Spatial model and isothermal sections of the ternary diagram are also presented. In regard to the formation of sigma in austenitic steels, it is pointed out that most, if not all, previous investigators have shown that sigma phase forms exclusively from the unstable ferrite and not from the austenite. The author thus emphasizes the view held only by one group of investigators.

Chapter 4 deals with intergranular corrosion specially in 18 : 8 stainless steels. After dealing with its cause, the methods of its detection and prevention, the author expresses doubts about the efficacy of its prevention in welding the titanium-stabilized stainless sheets by the niobium-stabilized welding rods, as emphasized in U.S.A. The next two chapters deal with the effects of manganese and silicon on iron-chromium steels, while the last one deals likewise with the ferrite stabilizers like aluminium, etc., and also copper and cobalt.

The first four chapters are very well illustrated with photomicrographs and have, of necessity, formed the bulk of the book material due to the industrial importance of these steels. Apart from a few printing errors, the book is so well written that engineers and others who are not conversant with metallography can most easily follow it.

R. C. DESHPANDE.

High Polymers. Vol. V. Part I. (*Cellulose and Cellulose Derivatives.*) Edited by E. Ott, H. M. Spurlin and M. W. Grafflin. (Interscience Publishers, Inc.), 1954. Pp. xvi + 509. Price $ 12.00.

A very welcome change in the second edition under review, is to break up the massive volume of the first edition into three parts of a more convenient size. There have also been of necessity some changes in the authors of some of the chapters. Much of the material has been rewritten to include the work done during the last 15 years. In various places the subject-matter has been re-arranged to achieve better continuity and avoid duplication. Throughout the book the policy seems to have been to emphasise the latest developments and wherever possible to condense earlier work in a review or merely refer to such reviews published elsewhere. This is certainly very desirable and has provided ample space for the discussion of recent work without making the book unwieldy.

In Chapter 3, the excellent historical survey of the chemical nature of cellulose and its derivatives by Purves remains largely unchanged. The review has been extended to include the recent postulates of weak acid-sensitive bonds in cellulose proposed by Husemann and Schultz and by Pacsu, and the criticism of these postulates by Mark and Tobolsky and by Jorgensen. The significance of alkali solubles has been rewritten and considerably expanded to include the work of Davidson and Nodder. Recent work on solubilities of α, β and γ celluloses in alkali under various conditions and the precautions necessary to interpret these data for technical use are also included. The section on "Degradation of Cellulose" has been admirably rewritten by McBurney and the important omissions, in the first edition, of microbiological and mechanical degradation, have been corrected. The oxidation of cellulose has been discussed from electronic concepts and the relation between the physical and inorganic characteristics of the oxidant and the nature of cellulose oxidation is given.

An introductory section by Mark has been added to Chapter 4 on the "Structure and Properties of Cellulose Fibres". Dealing with the general structural differences between high

polymers and ordinary organic compounds and the characteristic features of high polymer structure, this introduction serves as an excellent background for the rest of the chapter. An interesting detail is the change in terminology from native cellulose and mercerised cellulose to celluloses I and II. Omission of the secondary structure and cellulose particle theories has made it possible to discuss the Fringe-Micellar theory in greater detail. The chapter also gives an excellent review of the methods for determining the crystallinity and the present status of crystallinity concepts. The section on "Sorption of Water and Other Vapours on Cellulose" by Valko in the previous edition is replaced by "Structure Sorption Relations" by Howsmon in the present edition. A critical review of different sorption theories and an exhaustive account of the changes in the properties due to sorption are given.

The editors have done well in continuing their policy of selecting authors connected with both the industrial and the academic aspects of the cellulose field. In conclusion this book admirably fulfils their aim "to present the most important modern scientific and technical information concerning cellulose and its derivatives", and is sure to maintain a high place among the reference books in this field.

P. C. MEHTA.

Name Reactions in Organic Chemistry. By A. R. Surrey. (Academic Press, Inc.), 1954. Pp. viii + 192. Price $4.00.

As organic chemistry has developed, a large number of organic reactions have come to be named after those chemists who either discovered or developed them. This book gives an account of about one hundred of the more well known of such name reactions. Each reaction is described and discussed in space not exceeding 2 pages, and preceding each description, there is a short biographical sketch of the chemist or chemists after whom the particular reaction is designated. While the discussions are admittedly not as exhaustive as are the chapters in 'Organic Reactions', the scope and limitations of the various reactions have been outlined briefly and further recent developments, if any, have been mentioned. All the leading references are given and with the help of these, it is an easy matter for anyone wishing to obtain more information about any particular reaction to do so. The biographical notes give a short account of the life, background and contributions to chemistry of the various chemists and the inclusion of these sketches is a particularly attractive feature of the present volume.

S. SWAMINATHAN

Weeds. By Chandrika Thakur. (Published by Motilal Banarsidass, Patna), 1953. Pp. xv + 125. Price Rs. 7-8-0.

The book is divided into two parts. The eight chapters in Part I are meant to give the reader an idea of the classification of weeds, the losses caused by them and the methods of control. A certain amount of success has been achieved in the matter of details though one can normally expect a much higher standard of performance. Under 'Biological Control of Weeds' mention is made of the control of prickly pear in Australia. One misses reference to its control in South India. In Chapter III, it would have been helpful if examples had been given of the adaptations of fruits and seeds for dispersal and their mode of dissemination. A list of the implements in use in Bihar for weeding would have been welcome. The chapters on chemical control of weeds could have been more exhaustively dealt with.

Part II of the publication is an attempt to give information on weeds, their description, chromosome number, mode of propagation, control measures and economic importance. In this attempt the author has not fulfilled the expectations of a botanist. The order of description of the weeds neither follows a recognised system of classification nor an alphabetical order. The descriptions start with the family *Cyperaceæ* and end with *Cruciferæ*. The two subfamilies under *Leguminosæ*, viz., *Papilonaceæ* and *Cæsalpineæ* are separated. One of the serious drawbacks of the book is that old botanical names are retained. In certain cases as *Coccinia indica*, old names are given prominence. Mention of *Sorghum halepense* as *Holcus halepensis* is an error.

Under the heading 'description' two paragraphs are given. The first deals with the distribution and habitat of the plant and should have been separated under a different heading. The term 'description' cannot cover distribution.

As for the description of the weeds, this is incomplete. In a publication in which the author claims "an attempt has been made to describe some important weeds and to compile as much information as he could", it is hardly justifiable to give a very sketchy description in 3 or 4 sentences. In some cases no attempt has been made to record the shapes and arrange-

ment of the leaves, the details of floral parts, the description of fruit and seed and the placentation of the ovary which are the more important characteristics used in identification of any plant. The author does not seem to have consulted the publication, *A Handbook of Some South Indian Weeds*, by C. Tadulingam and G. Venkatanarayana published more than two decades ago, which is perhaps the first pioneer attempt in India on description of weeds. In the above book, 46 of the weeds described in the publication under review have been dealt with in a more exhaustive and comprehensive manner.

Information regarding the economic importance of the weeds is very brief and far from being useful. In many cases the particular portion of the plant of economic use and the disease for which it is meant is not stated, which considerably reduces the importance of the information.

It is doubtful if in its present form the book will be of much use to students and teachers of botany and agriculture, but it is hoped that the defects noticed will be remedied in the next edition. Attempts should be made to bring down the cost of the book, which is rather high for the matter contained. NAND LALL DUTT.

Indian Food Laws. Published by N. V. R. Iyengar, B. K. Sur and G. T. Kale (C.F.T.R.I., Mysore), 1954. Pp. iii + 220. Price Rs. 4-8-0.

Food adulteration control has not received the attention it deserves in India. Though a few provinces in British India had Statutory Acts, they were not effectively enforced. *The Law of Adulteration of Food and Drugs in British India*, by M. C. Mowar, published in 1937, gives a comparative account of the various Food Adulteration Acts then in force in eight provinces, besides some important legal decisions. In the following years also the working of the Act has been sporadic and there has been no uniformity in standards or in enforcement. But food adulteration being a concurrent subject, the Government of India have passed the Central Prevention of Food Adulteration Act recently and the future is hopeful.

The publication of the book under review at this juncture is timely and useful. It is much more than a compilation. It gives in about 200 pages a comparative account of the existing State Food Laws and Standards, Recommendations of the Central Committee for Food Standards, the Government of India Specifications for food purchased for the Civil and Defence requirements and under the Vegetable Oil Products Control Order. The book serves to focus public attention on the inadequacy of the existing provisions and the necessity for enforcing the Acts more effectively. Public analysts, health authorities and those who are called upon to frame regulations and standards under the Central Act would find the book very useful as a reference book.

S. NARAYANIER.

Table of Sine and Cosine Integrals for Arguments from 10 to 100. NBS Applied Mathematics Series 32. (Re-issue of Mathematical Tables 13). (Order from the Govt. Printing Office, Washington-25, D.C.). Pp. 186. Price $ 2.25.

The sine and cosine integrals have long played an important part in the theory of numbers and the calculus of probabilities. Lately, they have assumed increasing value in such fields as antenna theory, electromagnetic theory and nuclear physics.

This table contains Si (x) and Ci (x), $x = 10(\cdot 01)100$, 10 D. In addition there are auxiliary tables of multiples of $\pi/2$, $(\frac{1}{2}\ p)\ (1-p)$, $p(1-p^2)/6$ and $q(1-q^2)/6$ where $p+q=1$, to facilitate interpolation in the tables.

Table of the Gamma Function for Complex Arguments. NBS Applied Mathematics Series 34. (Order from the Govt. Printing Office, Washington-25, D.C.) Pp. 105. Price $ 2.00.

This table is of fundamental importance in both pure and applied mathematics. The tabulation was prompted by urgent and specific needs in the fields of atomic and nuclear research. The results presented here make the complex gamma function as accessible to workers as the more familiar exponential and trigonometric functions. This table gives the real and imaginary parts of $\log_e \Gamma(z)$ for $z = x + iy$, $x = 0(\cdot 1)10$, $y = 0(\cdot 1)10$ each to 12 decimals.

A comprehensive introduction contains a discussion of the important properties of the gamma function with methods for extending the range of the table. Auxiliary tables of $\sin \pi x$, $\cos \pi x$, $\sinh \pi x$ and $\cosh \pi x$ are given to 15 decimal places or 15 significant figures for $x = 0(\cdot 1)10$ to facilitate extension of the scope of the table.

Report of the Rothamsted Experiment Station, Harpenden, for 1953. (1954), Pp. 227. Price 7 *sh.* 6 *d.*

The Report covers the work of the 15 departments of the Rothamsted Experiment Station during the year 1953 under the Directorship of Sir William G. Ogg. It includes, as in earlier years, an account of the progress of soil survey of England and Wales by Dr. D. W. King, and three special reviews. The Director's introduction gives in 12 informative pages a summary of the work done during the year.

Among the important results obtained during the year is the finding on the nature of interactions between certain micronutrients and iron: it has been found that the ill-effects of the excess of manganese and molybdenum, on flax, soyabean, etc., can, as in the case of vanadium, be counteracted by increasing the supply of iron. One of the special reviews gives a full account of these observations. The leaf spraying work has been extended to the study of the effects of concentration of the nutrient solution. Spraying with sulphate of potash solution has led to an increase in the potash content of lucerne. In spite of employing isotopes, it was not possible to account for the observed loss of a part of nutrients sprayed. Root diseases in potted wheat plants were significantly reduced by antibiotics produced by some strains of actinomyces. The action of the latter, however, is often restricted by the adsorption of the antibiotics by the clay fraction. Some progress has been recorded in the work on nodule bacteria. Work on enzymes is continued on the three fronts, *viz.*, investigations on ribonuclease whose action is connected with cell processes and virus infection; on enzymes responsible for the oxidation of amino-acid derivatives and plant hormones; and on those acting on cellulose and chitin. Basic research on viruses has progressed relating to the rate of virus multiplication and the effects of ultraviolet radiation. Heat therapy was partially successful against virus infection: an interesting observation is that only viruses of spherical shape are inactivated by heat treatment. Eel-worm control work is mainly directed towards finding resistant crop varieties, suitable crop rotations and the influence of root diffusates. Research on insect migration and on gall midges and aphids is continued. An interesting finding is that certain caterpillars grow more rapidly when crowded together. The physical properties and toxicity of DDT and some related compounds has been dealt with in a special review. The finding that the behaviour of workers in honeybee colonies and the cohesiveness to the colony is due to the influence of "a queen substance", which the workers have been found to obtain from the queen and distribute in the colony, is indeed fascinating. A special review on bees as pollinators appears in the report. Work on phosphates is being continued. Survey of clay minerals has disclosed one or two new constituents. It has been possible to characterise the clay mineral responsible for potash fixation. For the extraction of leaf proteins, machinery is being designed and installed with a view to starting production in the current year.

Appended to the Report is a list with abstracts of 186 publications including 4 books, 4 reviews, 3 reports, 5 general publications and 140 research papers, mostly published in 1953 and 1954.

The above summary is barely indicative of the range and importance of the researches undertaken. The Report in its informativeness and in its general function of clarifying step by step the complex processes in soil, plant and parasite relationships conforms to its usual high standard. In this respect, the reviewer has little to add to his comments on last year's Report. The work is not confined to the British Isles and apart from the Pedological researches extended to Kenya, several of the experts were engaged in surveys and fulfilled advisory functions in different parts of the Commonwealth during the year. Students who worked at Rothamsted will be glad to note that there has been an extension of working accommodation at the Station, particularly in the Plant Pathology and Statistics Departments.

NAND LALL DUTT.

Books Received

Organic Analysis, Vol. II. Edited by John Mitchel, Jr., I. M. Kolthoff, E. O. Proskauer and A. Weissberger. (Interscience Publishers, Inc.), 1954. Pp. viii + 372. Price $ 8.50.

Engineering Metallurgy. By E. M. H. Lips. (Philips Technical Library.) [Agents in India: Philips Electrical Co. (India), Ltd., Calcutta-20], 1954. Pp. iii + 246. Price Rs. 22.

The Biochemistry of Semen. By T. Mann. (Methuen & Co., London), 1954. Pp. xii + 240. Price 16 *sh.*

Chemical Specificity in Biological Interactions. Edited by Frank R. N. Gurd. (Academic Press, Inc.), 1954. Pp. xv + 234. Price $ 6.00.

Optics—Lectures on Theoretical Physics. By Arnold Sommerfeld. (Translated from German by Otto Laporte and Peter A. Moldauer), 1954. Pp. xii + 383. Price $ 6.80.

Technique of Organic Chemistry, Vol. I, Part 3. (Physical Methods of Organic Chemistry.) Edited by Arnold Weissberger. (Interscience Publishers, Inc.), 1954. Pp. xi + 2097-2530. Price $ 8.50.

International Review of Cytology, Vol. III. Edited by G. H. Bourne and J. H. Danielli. (Academic Press, Inc.), 1954. Pp. v + 530. Price $ 9.50.

Automatic Protection of A.C. Circuits. Fourth Edition. Revised and Edited by C. M. Dodson. By G. W. Stubbings. (Chapman & Hall), 1954. Pp. xi + 355. Price 50 *sh.*

The Sources of Eddington's Philosophy. By Herbert Dingle. (Cambridge University Press), 1954. Pp. 63. Price 3 *sh.* 6 *d.*

The Aboriginal Races of India. By S. S. Sarkar. (Bookland Ltd., Calcutta-6), 1954. Pp. v + 151. Price Rs. 12.

Mass Balancing of Aircraft Control Surfaces. By H. Templeton. (Chapman & Hall), 1954. Pp. x + 241. Price 35 *sh.*

The Plant Quarantine Problem. By W. A. McCubbin. (Ejnar Munksgaard, Copenhagen), 1954. Pp. 255. Price 33 *sh.* 6 *d.*

Valves for A. F. Amplifiers. By E. Rodenhuis. (Philips Technical Library, Eindhoven, Distributors in India: Philips Electrical Co., 7, Justice Chandra Madhab Road, Calcutta), 1954. Pp. viii + 147. Price Rs. 5.

SCIENCE NOTES AND NEWS

Emergence of Buds in the Cultivated and Wild Species of *Oryza*

G. V. Chalam, Economic Botanist, Cuttack, reports that in the case of *O. sativa* and *O. glabrima* the emergence of bud is intra-sheath or intra-vaginal (as termed by Agrnes Arber), *i.e.*, the bud is enclosed with in the leaf-sheath. On the other hand, in *O. perennis* the emergence of bud is extra-sheath or extra-vaginal, *i.e.*, the bud pierces through the base of the leaf-sheath and grows outside the leaf-sheath. In two more wild species, *O. coarctata* and *O. granulata* examined, it was found that in the former the emergence of bud is extra-vaginal and in the latter the emergence is intra-vaginal. The author feels that while formulating any hypothesis on the origin of the cultivated species of rice this feature also has to be borne in mind.

Residual Toxicity of Some Organic Insecticides to Mustard Aphids

T. P. S. Teotia, Government Agricultural College, Kanpur, writes as follows:

In January 1954, a series of field tests was carried out to compare the residual effectiveness of endrin, lethane, lindane and parathion with nicotine for the control of the mustard aphis on *sarson*. The insecticides were applied at the rate of 1·8 lb. of 19·5 per cent. endrin emulsifiable concentrate, 0·7 lb. of lethane 60 (a 50 per cent. solution of thiocyanoethyl laurate), 1·4 lb. of 25 per cent. wettable lindane, 1·0 lb. of 25 per cent. wettable parathion, and 3·0 lb. of nicotox "20" (a soapless emulsion spray containing 20 per cent. actual nicotine), per 100 gallons of water per acre.

These tests were preliminary in nature, but indicate that two sprayings, at intervals of about 20 days, with parathion and lindane at the dosages tested would give an effective control of the mustard aphis in a season. Further investigation is necessary, however, before definite recommendations can be made.

Fermi Memorial Meeting

A public meeting in honour and memory of Enrico Fermi was held in Bombay on December 14, 1954. It was organized in the form of a symposium by the Tata Institute of Fundamental Research. The following speakers took part: P. A. M. Dirac—The Development of Fermi's Statistical Theory and of the Theory of β-Decay; D. D. Kosambi—Fermi's Theorem in Differential Geometry; K. S. Singwi—Slow Neutron Reactions and Reactor Development; B. Peters—Fermi's Theory of the Origin of Cosmic Rays; H. J. Bhabha—Fermi's Theory of Meson Production.

Raptakos Fellowships Award

The Raptakos Medical Research Board Fellowships for the year 1955 have been awarded to the following persons: B. S. Narasinga Rao (Nutrition Research Laboratories, Coonoor); V. V. Patwardhan (Indian Cancer Research Centre, Parel, Bombay); B. N. Mody (Grant

Medical College and J. J. Group of Hospitals, Bombay); P. P. Nair (Department of Biochemistry, Institute of Science, Bombay); and Victor M. Rao (Department of Surgery, Christian Medical College Hospital, Vellore, S. India).

Hora Medal for Fishery Research

The Council of the National Institute of Sciences of India, on the recommendation of the Chandra Kala Hora Memorial Medal Advisory Board, have decided to award the medal for the quinquennial period 1950-54 jointly to Sri. G. N. Mitra, Director of Industries (formerly Deputy-Director of Fisheries), Orissa, and Sri. K. H. Alikunhi, Research Officer, Pond Culture, Central Inland Fisheries Research Station, Cuttack. This medal is awarded for "conspicuously important contributions to the development of fisheries in India", including all aspects of biological, technological and sociological studies, including also the improvement of fishing nets and crafts and the betterment of the social and economic conditions of the fishermen. In fact, its scope includes any discovery or invention or new practical method which tends to increase fishery production in India on a paying basis.

The Indian Society of Genetics and Plant Breeding, New Delhi

The Fifteenth Annual General Meeting of the Indian Society of Genetics and Plant Breeding was held at Baroda on 8th January 1955, under the Presidentship of Dr. S. M. Sikka, Head of the Division of Botany, Indian Agricultural Research Institute, New Delhi, who delivered his Presidential Address on "The Genetics of Wheat". The following were elected as office-bearers for the year(s) specified against each :

President : Dr. T. R. Mehta (1955); *Vice-Presidents* : Drs. P. N. Bhaduri and G. S. Murty (1955-56); *Secretary* : Dr. M. S. Swaminathan (1955-56); *Treasurer* : Dr. D. Chatterjee (1955-56); *Editor* : Dr. B. P. Pal (1955-57); *Councillors* : Drs. T. S. Venkataraman, N. Parthasarathy, B. S. Kadam, R. H. Richharia, Pushkarnath and P. D. Gadkari (1955-56).

Carcinogens in Cigarettes

In the course of an editorial on the subject, the *British Medical Journal* (Nov. 20, 1954, p. 1,213) observes that the formation of some polycyclic hydrocarbon carrying carcinogenic properties during smoking has now been confirmed. Referring to the 4 papers of Cooper, Lindsey *et al.*, who have made this important contribution to our knowledge, it points out that these papers have shown the following, in order of publication : first, in cigarette smoke the polycyclic hydrocarbons, anthracene and pyrene, can be demonstrated by combined chromatography and spectrometry. Secondly, the conditions in the experiments simulated closely those of human smoking, and the temperatures encountered were those experienced in normal human smoking, being sufficiently high to account for the presence of polycyclic hydocarbons. Thirdly, the tars from all-paper cigarettes (in which chopped cigarette paper replaced the tobacco) contain several polycyclic hydrocarbons, which have been identified, the most important being 3 : 4 benzpyrene. And fourthly, when sufficiently large quantities of ordinary cigarette tar were examined 3 : 4 benzpyrene was detectable. Thus they show that both the tobacco and the paper of cigarettes during smoking yield 3 : 4 benzpyrene.

Academy of Zoology, Agra

Officers for 1955-57 : *President* : Dr. B. C. Mahendra ; *Vice-President* : Dr. S. P. Jain ; *Secretary* : Shri Surendra Sharma ; *Treasurer* : Capt. R. P. Varma ; *Member of the Council* : Shri C. P. Singh.

The Academy is an international organisation for the advancement of zoology in the East and is sponsoring the publication of a Journal entitled, *The Annals of Zoology*, from January 1955. Further particulars can be had from : The Secretary, Academy of Zoology, 164, Civil Lines, Agra (India).

Indian Phytopathological Society

The following Office-bearers have been elected to the Council of the Indian Phytopathological Society for 1955 : *President* : Dr. K. D. Bagchee, Dehra Dun ; *Vice-President* : Dr. M. J. Thirumalachar, Poona ; *Councillors* : Drs. M. R. S. Iyengar, New Delhi ; S. Sinha, Agra ; S. Chowdhury, Jorhat ; S. Vaheeduddin, Hyderabad Dn.; M. K. Patel, Poona ; and T. S. Sadasivan, Madras ; *Secretary-Treasurer* : Dr. R. Prasada, New Delhi.

Award of Research Degree

The Annamalai University has awarded the Ph.D. Degree in Chemistry to Sri. M. Balasubramanian for his thesis entitled "Synthesis of β-amino, $\alpha\beta$-unsaturated, and bisaminoaryl sulphones".

The Banaras Hindu University has awarded the Ph.D. Degree in Botany to Mr. J. N. Misra for his thesis on "Some Aspects of Indian Marine and Freshwater Algæ".

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PLANT ECOLOGY IN INDIA*

ECOLOGY is everywhere a relatively new science. In view of the complexity of our vegetation and the transformations it has undergone through human occupation for some 5,000 years, our progress in ecological studies is perhaps not as great as in some of the Western countries. Complex and varied as our forest types are, they nevertheless present over the greater part of the country a remarkable integrity and similarity. The bulk of the vegetation of India is of a tropical character, conditioned by a monsoon climate in which the severity of high summer temperatures is mitigated by the onset of the rainy season. While the similarity of the tropical vegetational types in the north and the south in structure and composition is striking—certain species of Anogeissus, Acacia and Terminalia exhibiting a wide range in both regions—there are, as may be expected, considerable differences in detail. The chief characteristic of tropical vegetation is the multiplicity of the constituent species, composed of grasses, herbs, shrubs, climbers and trees. The tropical evergreen forest presents a picture of a three-dimensional almost solid block of vegetation packed with herbs, shrubs, leaves and trees arranged in several storeys.

Tropical forests are essentially mixed forests. The variations in detailed composition are therefore far greater than is the case in temperate forests, where the number of species is smaller and the vegetation quite frequently assumes a more or less pure character. Add to this the fact, that except in the Eastern Himalayas, biotic influences have been at work for centuries and there is hardly any sizable block of vegetation now left in an undisturbed condition.

* Summary of Presidential Address by Sri. C. R. Ranganathan to the Indian Botanical Society Session held at Baroda.

The pursuit of ecological studies is therefore one of peculiar difficulty. Since the eco-system includes plants, higher animals including man, insects, micro-organisms in the soil, the soil itself, and the climatological factors, a proper appreciation of the causal factors at play depends on a working knowledge of many different aspects of the physical and biological sciences.

Some part of the difficulty in the study of plant ecology derives from the obvious but not always remembered fact that plants function in two media, the air and the soil. Being literally rooted in the soil and incapable of locomotion, they are fully subject to the annual cycle of climatic and atmospheric influences. These influences are modified by their community life and by the formation of a canopy, leading to the creation of a micro-climate. Climatic and atmospheric influences, such as rainfall, temperature, humidity, wind pressure, intensity of solar radiation, etc., are relatively easy to measure. This fact taken with the fact that light, heat and water are the chief determinants of plant growth has weighted the scales in favour of systems of classification based on sub-aerial factors. Since the nature of the soil itself is largely conditioned by the climate, these systems based on climate have worked very well. There are gaps in our knowledge of the climatic data relating to many parts of India. Meteorological coverage of the country is still very far from being full. Micro-climatic data under various types of forest cover are practically non-existent. These matters require to be attended to before any great advances can be made in the detailed classification of forest types.

In this connection, it must be stressed that a considerable part of the plant is underground. Any study of the factors influencing vegetation cannot be complete without a study of the soil supporting the vegetation. This is especially so because the reactions of vegetation on the soil factors are in general more profound than those on the atmospheric factors. Vegetation affects considerably the physics, chemistry and biology of the soil. These reactions are of particular importance in relation to the suitability or otherwise of the conditions for natural reproduction.

The difficulties involved in soil studies are obvious. Firstly the ramifications of the plants underground are hidden from view and the behaviour of the plants in response to changes in soil conditions cannot be directly observed. Secondly, experience has shown that while chemical analyses of soil may throw light on the chemical nature of the soil and its special features or pronounced deficiencies in plant nutrients, they are rarely specific enough to account for local variations in the vegetation or to throw light on problems of natural reproduction. Chemical anlyses are, moreover, expensive and time-consuming. pH determinations, foliar analyses and the like are frequently of limited interpretative value when viewed in isolation without reference to successional changes and do not furnish a reliable diagnostic of vegetational variations.

If the view is accepted that, so far as natural vegetation is concerned, it is the climate which paints the broad lines of the picture, while the soil fills in the details, we are still a long way from understanding exactly how the soil fulfils its role. In agriculture we can to a considerable extent influence the physical nature and chemical composition of the soil by tillage and fertilization techniques. But these measures are not available in forestry practice, except to a limited extent in nurseries and plantations. The fact that a particular soil can be artificially conditioned to grow a particular crop, whether agricultural or silvicultural, does not, however, provide an explanation for the absence over a given site of a particular constituent of the vegetational type which may be common or abundant in the same type elsewhere. It appears that our knowledge of our soils, especially of the factors which correlate them to the vegetation on them, is very imperfect. The soil is not a mere physico-chemical medium; it is also a biological medium. It may be that when we have a better understanding of the microbiology of our soils, we shall be in a better position to appreciate its role as a determinant of the flora.

The setting up of a composite organization for the promotion of ecological studies is therefore worth our serious consideration. If it is agreed that such an organisation should be created, it may have to include specialists in forestry, botany, zoology, meteorology, soil science including soil microbiology, soil conservation, agronomy and agrostology. Representation should be given to institutions dealing with applied research in these sciences, as well as to associations of scientists and the universities. Working out the details of the composition and functions of the proposed organization may well be the first step for setting ecological studies in our country on a sure foundation.

NON-LINEAR CONTINUUM MECHANICS*

FOR more than a century, which may be called the linear era, some of the best investigators devoted their whole attention to linearizing the mathematical formulation of physical problems. The well-known equations of Poisson, Laplace, the wave equation and the heat conduction equation have been fruitfully utilized in all branches of scientific activity and have contributed to the discovery and study of a number of new functions. Linearization has all the advantages of existence, uniqueness and stability. Unfortunately, such is not the case with non-linear problems which have now assumed importance in all branches of scientific research. A natural phenomenon is seldom the result of linearised superposed effects. Any event is the result of a number of others dovetailing into one another, and hence any attempt at the exact formulation of a physical problem produces non-linearity in our equations.

Hardly any serious attempt, except in the case of simple vibrational equations and some elastic problems, has been made to find out what the data and stipulations are which correspond to physical reality and ensure uniqueness and stability of non-linear solutions. The method of perturbations gives higher order approximations whose convergence cannot always be proved. A classical solution need not be the first term in a power series solution of the general equation, and hence the assumption of linear solutions as the first approximation vitiates the basis of discovering new solutions. Again, large non-linear deformations may bring in both the plastic and the anisotropic effects, thus making the problem even more complicated.

Despite all these difficulties a lot of research work has been published on non-linear problems in subjects like elasticity, fluid mechanics and vibrations. All the modern tools like tensor calculus, matrix algebra and topology have been used. The first symposium in Applied Mathematics of the American Mathematical Society, held at Brown University, U.S.A. in 1947, dealt with such problems. Two new effects, the Kelvin and the Poynting effects, which cannot be given by the classical linear theory, have been discovered. These confirm the experimental facts that, to shear a block, besides shearing forces suitable normal forces are also required.

It will be too much to expect that any non-linear theory can give all known results in the quantitative sense. One should be satisfied if it gives good qualitative results, not given by the linear theory, and good quantitative results when only comparative ratios are required. In practice a suitable approximation which should not amount to the linear theory, should be made so that it exhibits qualitatively the non-linear effects. For quantitative results the laws so found may be generalized and the constants fitted in, consistent with experimental results.

Non-linear problems can arise from any of the following causes: (*i*) body stress equations, (*ii*) boundary conditions, (*iii*) strain components, (*iv*) stress-strain relations, and (*v*) coefficients of the medium.

In fluid mechanics the linearization of the body stress equations has given rise to classical theories like that of slow viscous flow. Exact solutions of simple cases like that of a sphere moving through a viscous liquid do not exist. One approach, which has yielded some results is to treat the actual problem as the limiting case of an extended problem in which the body-stress equations can be exactly solved. This synthetic method has revealed the existence of semi-empirical theories like that of Prandtl's boundary layer theory. It has also shown that the order of the boundary layer thickness is greater than $R^{-\frac{1}{2}}$ the widely used value, R being the Reynold's number.

In 1935 a paper by B. R. Seth marked the beginning of a series of papers on this subject by a host of workers, including F. D. Murnaghan and C. Truesdell in America, W. M. Shepherd, R. S. Rivlin, K. H. Swainger, A. E. Green in England, R. Kappus in Germany, D. Panov, P. M. Riz and N. V. Zvolinsky in Russia and A. Signorini in Italy. In it the idea was stressed that for large deformations, finite components of strain should be used, and that these components, like the classical boundary conditions and body stress equations, should be referred to the deformed framework.

In 1937 F. D. Murnaghan combined the two ideas of the finite strain components and the retention of the higher degree terms in the strain energy function. By adjusting the constants in his formula for hydrostatic pressure he found good agreement with compressibility experiments even for pressures of 20,000 atmo-

* Abstract of Presidential Address to the Section of Mathematics by Dr. B. R. Seth, at the 42nd Indian Science Congress, Baroda, 1955.

spheres. M. Reiner has obtained the Kelvin and Poynting effects in fluid flow by retaining the second order terms in the stress-strain velocity relations. R. S. Rivlin showed that for incompressible bodies very general forms of the strain energy function can be successfully used. He has also obtained some exact solutions of the general equations for incompressible bodies.

BIOLOGICAL HAZARDS FROM A- AND H-BOMBS

IN the course of his Presidential Address* to the Pacific Division of the A.A.A.S., Prof. A. H. Sturtevant of the California Institute of Technology referred to the two possible types of damage through irradiation from the A- and H-Bombs: damage to the exposed individual and damage to the genes in his germ cells.

The first will be more or less immediate in its manifestation whereas the latter will have detectable effects only in future generations. This, however, is not the most basic distinction. Irradiation has a gross effect on tissues, resulting in the burns and other symptoms recognized as direct effects of heavy dosages; there is also an effect on the genes, leading to mutations.

The former, tissue effect, appears to be substantially absent at low doses, recovery from moderate effects is possible, and doses spaced well apart in time have little or no cumulative effects. It is on the basis of these effects that the "permissible" dose, to which it is supposedly safe to expose individuals, is calculated. But there is reason to suppose that gene mutations, induced in an exposed individual, also constitute a hazard to that individual—especially in an increase in the probability of the development of malignant growths, perhaps years after the exposure. There is, in fact, no clearly safe dosage—all high-energy radiation, even of low intensity and brief duration, must be considered as potentially dangerous to the exposed individual.

Let us now turn to the effects of irradiation on the genes of exposed individuals. Here again we are handicapped by the special difficulties of dealing with the genetics of man, for the quantitative determination of the genetic effects of irradiation requires much more refined techniques than are possible with man—a point that becomes obvious when one tries to evaluate the data available concerning the survivors of the Hiroshima bomb. There is sufficient evidence that quantitative results obtained with one organism cannot safely be applied to a wholly different kind of organism. However, there are certain general qualitative results that have now been so widely confirmed that we may confidently assert that they apply to all higher organisms, including man. These results are:

(*i*) High-energy irradiation produces mutations.

(*ii*) The frequency of induced mutations is directly proportional to the dosage of irradiation. There is almost certainly no threshold value below which irradiation is ineffective.

(*iii*) The effects of successive exposures are cumulative.

(*iv*) The effects are permanent in the descendants of the affected genes. There is no recovery.

(*v*) The overwhelming majority of these mutations is deleterious—that is, they seriously affect the efficiency of individuals in later generations in which they come to expression. These deleterious genetic effects may lead to early death or to any of a wide variety of defects, often gross ones.

There is a store of such undesirable genes already present in any population. What irradiation does is to add to this store.

* "Social Implications of the Genetics of Man", reported in *Science*, 1954, **120**, 405.

PROFESSOR M. OLIPHANT TO VISIT INDIA

PROFESSOR M. OLIPHANT, Director, Physical Laboratories, Australian National University, Canberra and President, Australian Academy of Sciences, will be visiting India during the months of March-April 1955, during the course of which he will deliver the Rutherford Memorial Lecture, at a few centres in India. The lecture at Madras will be delivered under the auspices of the Department of Physics, University of Madras, at the Senate Hall on 26th March 1955.

A METHOD OF BIOLOGICAL STANDARDISATION OF CRUDE TOTAL ALKALOIDS OF *RAUWOLFIA SERPENTINA*

C. N. SHAH* AND M. SIRSI

Pharmacology Laboratory, Indian Institute of Science, Bangalore

EXTRACTS of *Rauwolfia serpentina* are considered to be effective therapeutic agents for the treatment of hypertension[1-3] and in certain neuropsychiatric conditions.[4-7] Crude powdered root, extracts and tinctures of the root and total alkaloids are some of the forms in common clinical use. Recently, a few pure alkaloids claiming to possess high degree of therapeutic efficiency have been introduced.[8,9]

Although *Rauwolfia serpentina* and its various extracts are being widely used, very little has been reported on the methods of standardisation adopted to ensure uniform potency of these products. The present status of this drug compares with that of Ergot and Digitalis, in their early days of therapy and biological standardisation.

A reduction in 25 per cent. of the systolic blood pressure in anæsthetised dogs,[10] inhibition of the adrenolytic response of increased blood pressure in dogs under anæsthesia, decreased sympathetic predominance as observed by the ptosis of the eyelids in rodents given *Rauwolfia*[11] are some of the methods of bioassay in use.

The choice of an assay method is largely influenced by factors such as time, cost, materials and labour involved. In the first two procedures using dogs as experimental animals, the reaction, which is based on a quantal response, can be observed only once and more complicated and time-consuming statistical procedures are necessary for the evaluation of such tests. The graded ptotic responses of albino mice to single doses of the test substance has in addition to the above defects a high degree of subjective error.

In this communication we are reporting a method of biological standardisation which is sensitive, simple and amenable to statistical analysis.

The isolated seminal vesicle of the guinea-pig has been used for the evalution of sympatholytic effect and standardisation of the natural and hydrogenated ergot alkaloids[12-14]; and for the assay of sympatholytic drugs.[15] A comparable use of the isolated rat seminal vesicles has recently been suggested.[16] The principle of this technique has been used for this bio-assay.

The laboratory standard (Sample A) was the total crude alkaloids extracted from a batch of powdered roots of *Rauwolfia serpentina* Benth. (Dehra Dun variety) yielding 2·12 per cent. w/w total alkaloids. This has been found to possess suitable sedative and hypotensive properties. The test substance (sample B) was from another batch of *Rauwolfia* roots which yielded 3·2 per cent. w/w of crude total alkaloids. These alkaloids were dissolved in propylene glycol and diluted further to the required concentration of 1 mg./1 ml.

The perfusion solution for the uterus had the following composition: NaCl 9·0 g., KCl 0·42 g., $CaCl_2$, $2H_2O$ 0·24 g., $MgCl_2$, $6H_2O$, 0·005 g., $NaHCO_3$ 0·5 g., glucose 0·5 g. per litre.

Adult rats of 200-50 g. were used in these experiments. Seminal vesicles, immediately on removal, were suspended in a 15 c.c. bath containing the oxygenated perfusion fluid. The tissue chamber was continuously oxygenated and maintained at 37° C.

Adrenalin dose giving a suitable contraction height of the seminal vesicle was first determined and repeated till the last three responses did not vary more than ± 5 per cent. from their average. Varying dosages of the total alkaloids were added and allowed to remain in contact for 1 minute before the adrenal inhibition was recorded. The different doses were added only after the vesicle had regained its original height of contraction to adrenalin each time. Controls using propylene glycol did not exhibit any inhibitory action.

The protocol of one experiment using five graded doses of samples A and B is given in Table I. For rationalisation of procedure the doses of each sample were alternated.

When log dose A is plotted against percentage reduction as ordinate, the line A in Fig. 1 is obtained. When log dose B is similarly plotted, the line B is obtained which is parallel to A. By noting the distance between the lines A and B along the x-axis, it was calculated that sample B is 1·26 times stronger than A. Since the two samples of crude alkaloids used are quantitatively equal on weight to weight basis, the difference in activity is definitely due

* Research Scholar, *Sarabhai Chemicals*, Baroda.

TABLE I

Comparison of sympatholytic activity on rats isolated seminal vesicle

Adrenalin contraction in mm.		Reduction of height in mm.	% reduction	Dose in mg. per 15 ml. bath
Before	After			
		Sample A		
44	36	8	18	0·2
44	28	16	36	0·4
40	17	23	57·5	0·6
41	13	28	68	0·8
45	8	37	82	1·0
		Sample B		
44	32	12	27	0·2
44	27	17	38·5	0·4
39	11	28	70	0·6
42	11	31	74	0·8
44	7	37	84	1·0

A—Laboratory Standard; B—The Test Substance.

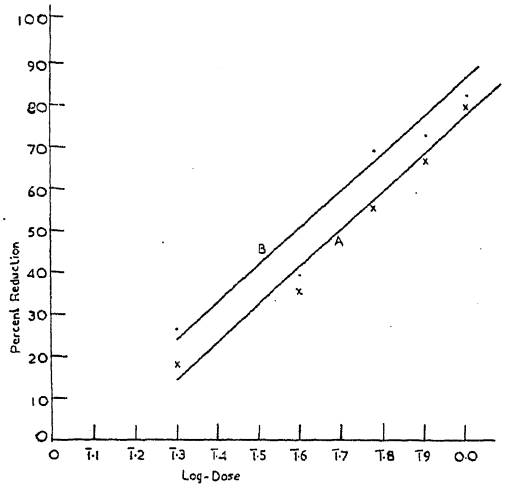


FIG. 1. Graph of log dose plotted against percentage inhibition of adrenaline effect by *Rauwolfia* alkaloids.

A—Laboratory Standard
B—The Test Substance

to the varying potency of the different fractions which constitute the crude alkaloids. Hence it can be stated that the second sample (B) is 1·26 times more active biologically than the laboratory standard (A).

Since the test is based on quantitative adrenolytic response it is possible to repeat the doses many times on the same test object. By suitable arrangement of the laboratory standard and the test preparation, sources of error such as variation between animals, can be eradicated.

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VIRUSES AND THE CONTROL OF INSECT PESTS

DR. KENNETH M. SMITH, of the Agricultural Research Council's Virus Research Unit, at Cambridge, has contributed an interesting article (*Discovery*, November 1954) which outlines both the fundamental knowledge of insect viruses that has recently been obtained and their use in the control of insect pests. Thus, the alfalfa butterfly in California has been effectively controlled by spraying the crop with stored polyhedra obtained from diseased caterpillars, and the pine sawfly in Canada has been controlled by a virus of polyhedral type procured from Sweden. A very interesting discovery is that some virus diseases are not highly specific, but can attack a number of different species of Lepidoptera; sometimes the virulence of the infection can be increased by mixing two viruses. In general, the persistent nature of the viruses and the fact that they do not affect the natural enemies of the pests make them a promising alternative to insecticides.

THE DIATOM, *FRAGILARIA OCEANICA* CLEVE, AN INDICATOR OF ABUNDANCE OF THE INDIAN OIL SARDINE, *SARDINELLA LONGICEPS* CUV. AND VAL.*

R. VELAPPAN NAIR AND R. SUBRAHMANYAN

Central Marine Fisheries Research Sub-Station, Kozhikode

THE oil sardine fishery has contributed in no small measure to the economy of the fisherfolk of the West Coast of India, and apart from its food value, the fish has sustained prosperous oil and guano industries for well over a century.[1] The fishery, however, is subject to extreme fluctuations and its continuous failure during the forties extending over several years had disastrous consequences on the fishing industry. Factors governing these fluctuations have been the subject of investigations for over three decades.

Since the inception of the Marine Fisheries Research Station of the Government of India, sardine investigations have been actively pursued at the Sub-Station at Kozhikode, which was set up in 1948. Intensive studies on the biology and fishery of the oil sardine and related subjects have been in progress with the primary object of determining the causes responsible for the fluctuations encountered in the fishery. One of the aspects of study related to the food and feeding habits of the different age groups of the oil sardine with special reference to the seasonal changes in the composition of its food, both in quantity and quality. Even during the early phase of this investigation, it became apparent that the oil sardine is a plankton feeder showing a special preference for phytoplankton, with the diatom *Fragilaria oceanica* forming a major constituent of its food. Further studies have revealed that *Fragilaria oceanica* constitutes the main component of the food of the juveniles which form the mainstay and bulk of the commercial fishery and also, occasionally, of the adult oil sardine.[2]

From the accounts so far published, it would appear that blooms of *Fragilaria oceanica* in the Indian waters are confined to the Laccadive Sea. This diatom is absent in other places, or if present, it occurs only in such small numbers as to be easily overlooked. Very rarely, a few numbers have been encountered on the Madras Coast.[3] It is interesting to note in this connection that large-scale shoaling of the oil sardine is confined to this region of the West Coast where the diatom also occurs in abundance.

Intensive studies on the qualitative and quantitative aspects of phytoplankton production and of the major constituents of the marine flora have been in progress simultaneously and these have shown that phytoplankton production attains its peak during the South-West monsoon months (June-September) and one of the major, if not the foremost, constituents of the peak is *Fragilaria oceanica*. This diatom, which forms flat, ribbon-like colonies, generally attains the height of its development between June and October, the intensity of its development fluctuating to some extent from time to time. Continuous observations over a period of seven years have indicated that the diatom has an asexual vegetative phase in its life-cycle lasting from three to four years, after which it forms auxospores, presumably by a sexual process; this process rejuvenates the protoplast and large new cells are formed which multiply by repeated vegetative divisions. The presence of considerable numbers of chains composed of large cells at three to four year intervals permits this interpretation. It is well known that in diatoms, immediately after auxospore-formation, the rate of vegetative multiplication is rather fast and that this rate slows down gradually as the cells undergo repeated divisions until auxospore-formation again provides the necessary stimulus for renewed activity.[4,5] Thus, in the present instance also, every four years or so, the *Fragilaria* bloom is more intense than during the in-between years. During the period of investigation in the present area two such blooms, one in 1949 and the other in 1953, were observed. These fluctuations in the bloom of *Fragilaria*, and thus its availability, seem to show an interesting relationship with those of the oil sardine fishery.

The oil sardine fishery commences along the West Coast with the onset of the South-West monsoon and the stock at this time is composed of active spawners.[2] These disappear with the cessation of the monsoon and the juveniles enter the fishing grounds in enormous shoals to contribute to the bulk of the

* Published with the permission of the Chief Research Officer, Central Marine Fisheries Research Station, Mandapam Camp.

commercial landings during the peak period of the fishery. As pointed out by Panikkar,[6] all previous workers are unanimous in ascribing the success of the oil sardine fishery to the abundance of the juveniles only. It is significant that the peak of the oil sardine fishery, when the juveniles dominate the catches, is reached during or immediately after the peak of *Fragilaria oceanica*. Further, a secondary maximum in the bloom of this diatom has also been observed during certain years accompanied by heavy landings of juvenile sardines. The influence of this diatom on the oil sardine was markedly noticed during the 1951-52 season when the fishery which was steady till October 1951, suffered a severe setback during the subsequent months owing to the scarcity of *Fragilaria* in the fishing grounds. The fishery revived with the reappearance of the diatom by the end of December 1951.

These investigations on the oil sardine and *Fragilaria oceanica* extending over seven years lead to the inescapable conclusion that one of the major factors governing the fluctuations of the oil sardine is the availability of *Fragilaria oceanica* which is its favourite food.[2] It was mentioned above that during the last seven years *Fragilaria* attained two outstanding peaks in the years 1949 and 1953 caused by the rejuvenation process in its life-history. It would appear that the bloom of 1949 may have helped the recovery of the oil sardine fishery which was a continuous failure for several preceding years. This progressive recovery of the fishery culminated in the exceptionally good 1953-54 season, which coincided with the second outstanding bloom of *Fragilaria* in 1953, when the heavy landings composed of juveniles contributed to one of the most successful fisheries during the last quarter of a century. It may be pointed out that the next outstanding bloom of *Fragilaria oceanica* is expected in 1956-57 and this surmise together with the expected good recruitment consequent on the abundance of the spawners in the fishery of the current season, i.e., 1954-55, indicates a good oil sardine fishery during that season, provided the hydrological and other factors are also favourable.

Our thanks are due to Dr. N. Kesava Panikkar for his keen interest and valuable suggestions.

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CONQUEST OF SOLAR ENERGY

THE harnessing of huge amounts of energy now going to waste in the desert and arid areas of the earth was the topic of a symposium held recently at New Delhi under the joint auspices of UNESCO and the National Institute of Sciences of India.

One of the most striking papers presented was that of Professor V. A. Baum, Head of the Heliotechnical Laboratory at the G. M. Krzhizhanovsky Power Institute at Tashkent in the Soviet Union. With nearly a million square miles of arid lands, the use of solar energy is being treated as a major problem in the U.S.S.R.

In Tashkent, every square metre of land receives more than a million kilocalories of sun energy per year, and the Soviet scientists have succeeded in developing paraboloid reflectors ten metres in diameter which produce 100 lb. of steam per hour at a pressure of 100 lb. per square inch. Such heaters have been used for the operation of canneries, for distilling water, operating refrigerators, and for heating the laboratory. In another application, solar heaters have been developed to make fresh water from salt. A practical still of this type has been used to make 75,000 tons of distilled water and 12,000 tons of ice a year.

The U.S.S.R. State Optical Institute has constructed a number of solar kitchens using aluminium mirrors 4 feet in diameter which can produce 6 quarts of boiled water per hour. Work is now continuing to develop a solar steam generator which can be used as a heating plant in winter and a cooling plant in summer for cinemas, hospitals and houses. The development of ice-making and of air-conditioning is considered especially important in those arid regions where the suffering of the population from heat in summer is as severe as that from cold in the winter.

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GLAUBER APPROXIMATION FOR SCATTERING

AN approximation valid for high energy and small angle scattering has been suggested by Glauber.[1] In this approximation the free particle Green's function in cylindrical co-ordinates is given by,

$$G(\mathbf{r},\mathbf{r}') = -i\tfrac{1}{2}k^{-1}\cdot\exp\{i|\mathbf{K}|(z-z')\}\,\delta(\rho-\rho') \quad z>z' \qquad (1)$$

$$G(\mathbf{r},\mathbf{r}') = 0 \quad z<z'$$

where $\mathbf{K} = \tfrac{1}{2}(\mathbf{k}_0 + \mathbf{k}_1)$ and $\mathbf{k}_0$ and $\mathbf{k}_1$ are the propagation vectors for the incoming and the outgoing waves respectively. Further using this $G(\mathbf{r},\mathbf{r}')$, the Born series for the scattering amplitude has been summed. For a central potential this leads to

$$f(\theta) = (ik/2\pi)\int_0^{2\pi} d\phi \int_0^{\infty} \rho d\rho\; e^{-i(\mathbf{k}_1-\mathbf{k}_0)\cdot\rho}\,[1-e^{2i\delta(\rho)}] \qquad (2)$$

where

$$\delta(\rho) = -\frac{1}{\hbar v}\int_0^{\infty} V[(\rho^2+z^2)^{\frac{1}{2}}]\,dz$$

The form of $G(\mathbf{r},\mathbf{r}')$ in this approximation allows the secondary waves to move forward along the z-axis only. Therefore it is reasonable to suppose that this approximation may be in some way analogous to the classical approximation. Further using the optical theorem,

$$\sigma_t = (4\pi/k)\ Im\, f(0) \qquad (3)$$

and substituting for $f(o)$ from (2) we obtain

$$\sigma_t = 4\pi \int_0^\infty \rho d\rho\ Re\,[1-\exp\{2i\delta(\rho)\}] \qquad (4)$$

which is the same as obtained by the classical approximation.[2] In this approximation the total wave function $\Psi(r)$, in the cylindrical coordinates, can be written as

$$\Psi(r) = \exp[i\{(k_0\cdot\rho)+|K|\,z+\delta'\}] \qquad (5)$$

where

$$\delta' = -\frac{1}{\hbar v}\int_{-\infty}^{z} V[(\rho^2+t^2)^{\frac{1}{2}}]\,dt \qquad (6)$$

By using this wave function we have also obtained σ_t from the usual expression

$$\sigma_t = -(2m/\hbar^2 k)\ Im \int e^{-ik_0\cdot r} V(r)\,\Psi(r)\,dr \qquad (7)$$

It is interesting to note that though $\Psi(r)$ from (5) does not have the correct assymptotic form, yet when substituted in (7), it gives the same expression for σ_t as given by (4). Further, the absorption cross-section can be written as

$$\sigma_a = -\frac{2m}{\hbar^2 k}\ Im \int \Psi^*(r^*)\,V(r)\Psi(r)dr \qquad (8)$$

wherefrom we obtain

$$\sigma_a = 2\pi \int_0^\infty \rho d\rho\ [1-|\exp\{2i\delta(\rho)\}|^2] \qquad (9)$$

which is equivalent to that obtained by the classical approximation.[2] This strengthens the similarity of this approximation with the classical approximation.

Glauber[1] mentions about obtaining this approximation from a W.K.B. approximation of the incident plane wave. We proceed to obtain it by a W.K.B. partial wave analysis. Use of the W.K.B. approximation in scattering by a central potential gives the phase shifts by a well-known simple formula

$$\eta_l = -\frac{1}{\hbar v}\int_0^\infty (r^2-\nu^2)^{-\frac{1}{2}}\,V(r)\,r dr \qquad (10)$$

where

$$\nu = (l+\tfrac{1}{2})/k$$

Using this expression for η_l in the usual expression for the scattering amplitude and carrying out simple transformations and remembering that $\nu > 0$ we obtain

$$f(\theta) = i\int_0^\infty \rho d\rho\,[1-\exp\{2i\delta(\rho)\}] \left[\sum_{l=0}^{\infty}\delta(\rho-\nu)\,P_l(\cos\theta)\right] \qquad (11)$$

At this stage we introduce two well-known approximations. We convert the sum over l into an integral over ν and use the relation

$$P_l(\cos\theta) = J_0[(2l+1)\sin(\theta/2)] \qquad (12)$$

valid for large l and small θ. Thus we obtain

$$f(\theta) = ik\int_0^\infty \rho d\rho\,\{1-e^{2i\delta(\rho)}\}\,J_0(|k_1-k_0|\rho) \qquad (13)$$

which is the same as the expression obtain by the angular integration of the Glauber e pression given in equation (2). Thus we co clude that the Glauber approximation is a sil plified form of the classical approximation.

M. G. Science Institute, K. M. GATHA
Navarangpura, A. L. MATHUR
Ahmedabad-9,
September 10, 1954.

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TEMPERATURE DEPENDENCE OF VISCOSITY

It is a well-known fact that viscosity a free volume of a liquid are related. If η r presents the viscosity of a liquid at temper ture t and V_f its free volume at the same ter perature, then they are assumed[1] to be relat as:

$$\eta V_f^{\alpha} = \text{constant}, \qquad (1$$

where α is some constant whose value fro experimental data is approximately unity f normal liquids, *i.e.*, the viscosity is inverse proportional to the free volume:

$$\eta = \frac{C}{V_f} \qquad (1'$$

C being a constant. The equation (1') h been derived by Mukherjee[2] from other cons derations.

Now, from the consideration of the partiti function of a molecule in the liquid it w shown by Eyring[3] that the free volume of liquid is related to its molar volume by t expression:

$$V_f = (cRT/\Delta E_{vap.})^3\ V, \qquad (2$$

where V represents the molar volum $\Delta E_{vap.} = (L-RT)$, L being the normal late heat of vaporization, and as a first approxim tion c may be considered a constant who value is 2 for cubical packing in the liquid.

Combining (1') and (2) we get

$$\eta = \frac{A}{V}\left(\frac{L}{T}-R\right)^3 \qquad (3$$

A being another constant. V is a function temperature. The coefficient of thermal expan sion of a liquid can be defined by the follow ing expression

$$\alpha = \frac{1}{V}\left(\frac{dV}{dt}\right)_p$$

Assuming α to remain constant, we have o integration

$$V = ke^{\alpha t}. \qquad (4$$

So that (3) takes the form

$$\eta = K\left(\frac{L}{t+273\cdot1} - R\right)^3 e^{-\alpha t} \qquad (5)$$

For more accurate representation of the phenomenon we must consider the variation of L with T and the inadequacy of the assumption of α to be a constant. For many substances variation of L with T may be represented by[4]

$$L = L_0 - aT$$

and the thermal expansion of a liquid is generally expressed by a polynominal of the type

$$V = V_0(1 + at + bt^2 + ct^3)$$

Substituting these expressions in (3) and (4) we get

$$\eta = K' \frac{\left(\frac{L_0}{t+273\cdot1} - B\right)^3}{1 + at + bt^2 + ct^3} \qquad (6)$$

where K' is a new constant and B a constant different from the gas constant R. It is surprising that if we altogether neglect the variation of V with T, the resulting formula

$$\eta = \left(A + \frac{B}{T}\right)^3$$

is well applicable to many liquids.

Details of work in this direction and tests of above equations will be published elsewhere.

The author is grateful to Dr. K. Majumdar for his interest in the investigation.

Dept. of Physics, SHASHANKA SHEKHAR MITRA.
Allahabad University,
Allahabad, *October* 5, 1954.

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VIBRATIONAL ANALYSIS OF TANTALUM OXIDE BANDS

TANTALUM OXIDE is known[1,2] to give extensive bands in the infra-red, visible and near ultraviolet regions. These are developed in a D.C. arc between tantalum rods and photographed under high resolution and different dispersions including that of a 21 feet grating second order. The bands occurring in the region λ 3400-λ 4800 could be divided into two systems designated as A and C corresponding to the visible and infra-red systems of columbium oxide[3,4] and vanadium oxide.[5,6] The vibrational structure in the two systems has been obtained; the analysis indicates a common lower state for the two systems. While system A consists of single bands, system C shows two components for each band separated by a wave number interval of about 180 cm.$^{-1}$; the second system indicates an upper π state. The vibrational constants ω_e and $x_e\omega_e$ are 1040·0 and 8·5 cm.$^{-1}$ for the common ground state. The approximate corresponding values for the upper states of systems C and A are 718·6, 2·2 and 901·4, 4·0 cm.$^{-1}$ respectively. About 35 band heads have been included in the analysis comprising of practically all the observable band heads. This analysis differs from that previously reported by Krishnamurthy and Fernando[2] which does not account for quite a number of the intense heads. A detailed discussion will be presented elsewhere together with the rotational structure which has been obtained for the (0, 0) and (1, 0) bands of system C and the (0, 0) band of system A.

Physics Dept., D. PREMASWARUP.
Andhra University, Waltair,
November 6, 1954.

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SEPARATION AND GRAVIMETRIC DETERMINATION OF URANIUM AS PHOSPHATE IN PRESENCE OF COMPLEXON

PROPERTY of complexon II to form stable complexes with Hg, Pb, Cu, Cd, Fe, Al, Cr, Ni, Co, Mn, Zn, Th, Ce, La, Ca, Sr, Ba and Mg in ammoniacal solution has been used by Pribil and Vorlicek[1] to separate uranium quantitatively as $(NH_4)_2U_2O_7$ from these cations. Diuranate is finally ignited and weighed as U_3O_8. Hure, Kremer and Berquier[2] have also found that more stable complexes are formed with these cations towards $(NH_4)_2HPO_4$ with complexon at pH 5. The present author therefore used this property for the quantitative separation of uranyl radical as $UO_2NH_4PO_4$ which can be quantitatively precipitated and finally ignited completely to $(UO_2)_2P_2O_7$ at 1000° C. This has many advantages over Pribil and Vorlicek's ammonia precipitation of uranium. Since precipitation is done at pH 5 the adsorption and co-precipitation of radicals precipitated by ammonia is avoided. Further,

unlike ammonium precipitation, the phosphate precipitation can be carried out even in the presence of phosphoric and sulphuric acids. Finally the initial voluminous precipitate of $UO_2NH_4PO_4$ allows smaller quantity of the material for the determination of uranium.

The details of the procedure are identical with those described by Hure.[2] Results are shown in Table I.

TABLE I

Determination of uranium as phosphate in presence of complexon

Sr. No.	U_3O_8 taken mg.	Fe_2O_3 added mg.	Al_2O_3 added mg.	CaO added mg.	CuO added mg.	ThO_2 added mg.	Ce_2O_3 added mg.	TiO_2 added mg.	U_3O_8 found mg.
1	50	10	10	..	..	..	..	..	50·24
2	25	..	..	..	..	10	10	..	24 92
3	12·5	..	..	6·5	5·0	..	..	..	12·52
4	12·5	..	..	..	..	..	..	2·0*	12·57
5	101·5†	4·8	..	..	..	..	..	..	101·80
6	50	5	5	5	5	5	5	..	50·18

* One ml. of H_2O_2 (30% by volume) was added before phosphate precipitation. † Uranyl nitrate solution containing 101·5 mg. U_3O_8 by usual method and containing also 7·5 mg. of rare earth oxides.

The only serious interferences are given by beryllium and titanium, although small amounts of titanium can be complexed by adding a few drops of hydrogen peroxide before the addition of the reagents. Thus this provides a quick method for the determination of uranium in high grade ores (free from titanium), in alloys and in uranyl compounds.

Chemistry Division, MAHADEO M. TILLU.
Dept. of Atomic Energy,
Bombay-28, *November* 11, 1954.

1. Pribil, R. and Vorlicek, J., *Coll. Czech. Chem. Communs.*, 1951, **16**, 216-18.
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SWASH AND THE BREAKER ZONE

IT is generally known that for a given height the upward sweep of the waves on the beach, called swash, varies with the slope of the beach. The more gentle the slope above tide level, the greater will be the swash distance, and *vice versa*. The slope of the beach below tide level determines the distance from the tide level line at which the waves will break, since, plunging type waves are known to break in water whose depth is equal to their height.

A change in the slope of the beach below tide level will influence both the location of the wave plunge point and the length of swash. The following discussion develops the relationships between beach slopes, the character of the swash, and the breaking point of the wave.

Making use of the notation in Fig. 1 A, the following formulæ may be derived. Three cases are considered.

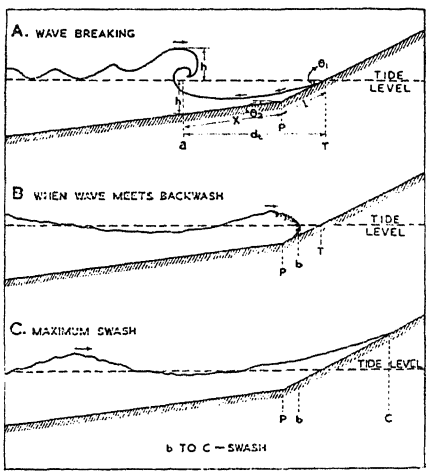


FIG. 1. Wave plunge point and swash.

Case I.—Slope changes below the tide level, *i.e.*, $\theta_1 \neq \theta_2$ and l is finite. Assuming that the wave breaks at a point where the depth is equal to its height

$$h = x \sin\theta_2 + l \sin\theta_1$$

and $$d_t = x \cos\theta_2 + l \cos\theta_1.$$

Case II.—Slope changes exactly at the tide level, *i.e.*,

$$\theta_1 \neq \theta_2, \text{ and } l = 0.$$

Here, $h = x \sin\theta_2$; $d_t = x \cos\theta_2 = h \cot\theta_2$.

Case III.—The slope of the beach is uniform, *i.e.*,

$$\theta_1 = \theta_2$$

$$h = x \sin\theta_1 + l \sin\theta_1;$$

and $$d_t = x \cos\theta_1 + l \cos\theta_1;$$

from which, it follows that

$$d_t = h \cot\theta_1.$$

From this the following conclusions may be drawn:

(1) When the slope of the beach is constant throughout, the distance between the point where the wave breaks and the edge of the water (d_t) remains the same, for a constant wave-height;

(2) When the slope changes below a tide level, and if it is capable of influencing the wave, then the distance d_t has one value; if the change of slope is at

a point so far away that it is not capable of influencing the wave even at lowest low-tides, then d_t remains the same throughout. The distance d_t changes only when the tide reaches a certain height, when a change in slope is capable of influencing the waves.

(3) When the slope changes exactly at a tide level, the situation is similar to the case when the slope is constant, only the value below tide level being effective.

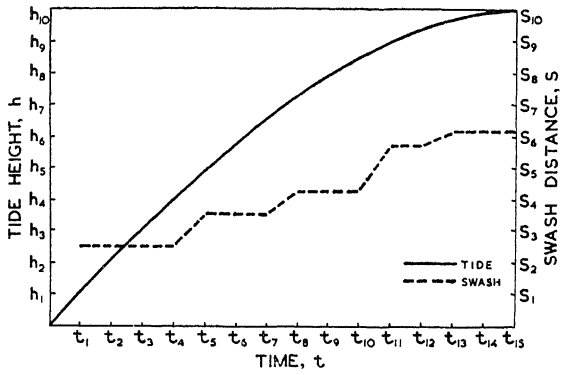


FIG. 2. Theoretical curve of variation of swash distance with tide.

With the recession of the tide, the swash zone also recedes down the beach; also the swash distance does not remain the same, if the slope changes at a distance l below a tide-level, for a given wave-height. Distance of swash and back-swash were measured by noting the distance between the farthest movement of swash and the maximum point to which water recedes. At the time of the observation, the height of the tide with reference to the beach could be obtained from tide gauge records, from which the swash distance is calculated. Thus, if several observations are taken of the swash distance, and if after a time the swash distance suddenly changes, as shown in Fig. 2, it means that there is a change in the slope of the beach below water, when the tide is at that particular level. If there is more than one break in this line, it means that there are more slopes. But in practice, the swash curve need not be so uniform as shown in Fig. 2, but it may be a zig-zag line, with major breaks at points where major changes in slope are found. This zig-zag line can be due to the irregularity in the minor changes in slope, or due to small variations in wave-height.

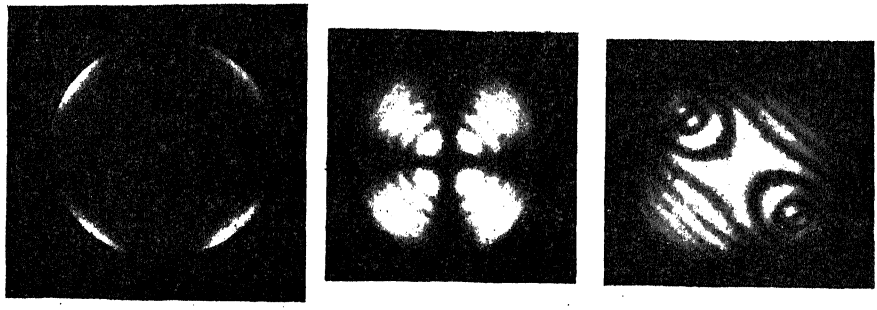
In this discussion, three assumptions are made: (1) the slope of the beach is a perfect straight line; (2) the wave-height is constant throughout the period when the observations are taken; and (3) the waves are plunging type and not 'spilling' type.

Thanks are due to Professor C. Mahadevan and Professor E. C. La Fond for their continued interest in the work.

Dept. of Geology, R. PRASADA RAO.
Andhra University,
Waltair, *November* 10, 1954.

INTERFERENCE FIGURES IN REFLECTED POLARIZED LIGHT

NEUERBURG[1] has reported optical figures on opaque minerals observed under the reflecting microscope. A number of minerals, normally transparent in thin sections, were examined under reflected polarized light, on the Leitz Panphot microscope, with its equipment for incident polarized light and polarizing vertical illuminator. High power objectives, both with long and short stem, were used. Plane cleavage surfaces or crystal faces, and flaky surfaces in the case of micaceous minerals were employed. The specimens were from about 1 mm. to 15 mm. thick. The results are given below:



1 2 3

FIGS. 1-3

(1) All surfaces of minerals (irrespective of the system of crystallization or crystallographic orientation) which showed a dark surface under crossed nicols, gave a "uniaxial figure" of the type observed on a plane glass (Fig. 1). This figure showed no change on rotation of the stage and had no relation to the optical properties of the minerals.

(2) Rhombohedral faces of iceland spar, and prismatic faces of clear transparent aragonite gave "uniaxial figures", which, on rotation showed a small "optic axial angle", in the direction of the longer diagonal in the case of iceland spar, and in the direction of the lateral axes in the case of aragonite. This small "optic axial angle", which is of the same magnitude in both the cases, has no relationship to the optical properties of the minerals.

(3) Such surfaces, or parts and patches of surfaces, as showed interference colours under crossed nicols, gave interference figures similar to those obtained in transmitted polarized light. For instance, (100) faces of perthite and microcine showed a negative acute bisectrix figure, and (001) faces optic normal figures. Kyanite showed an acute bisectrix figure on (100) face.

(4) Micaceous minerals like muscovite, phlogopite and vermiculite showed interference figures perfectly like those obtained in transmitted polarized light. Whatever the thickness of the muscovite book employed, above 1 mm. up to 10 mm., the lemniscates showed often 8 orders of violet rings, thereby indicating that there is a penetration of the polarized reflected rays to a depth of about ·6 mm. The figures obtained on phlogopite and muscovite are shown in Figs. 2 and 3.

The interference figures obtained here may be explained as follows: (1) In the case of minerals whose surfaces are dark under crossed nicols, the phenomenon is due to the scattering of light in the medium. (2) In the case of micaceous minerals and minerals with cleavages, the figures are due to the penetration of light into the mineral, and its reflection from below.

Dept. of Geol. and Geophysics, University of Madras, *November* 4, 1954.

P. R. J. Naidu.

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ANGIOSPERMOUS PLANT FOSSILS FROM THE LAMETA LIMESTONES OF MADHYA PRADESH

This note places on record for the first time, the important discovery of Angiospermous plant fossils from the Lameta limestones near Chhindwara District in Madhya Pradesh.

During the geological survey and mapping of some parts of the Chhindwara District in April last, Choudhary, one of my post-graduate students, collected a few samples of a limestone lying immediately below the Deccan traps, in which was found a small fragment of an indistinct leaf impression. Since the impression proved to be of considerable interest, the area was re-visited and a good collection of fairly well preserved leaf impressions and a few pieces of fossil wood was made.

Dr. Fermor[1] had reported the occurrence of a gritty impure limestone from the Chhindwara region similar to the Lameta limestone, occurring below the traps, which he considered to be of metasomatic origin. True sedimentary Lameta beds have not hitherto been reported from this area. Therefore the occurrence of an undoubted Lameta horizon from this locality is of considerable interest.

The Lameta exposure now under report is about 3 miles fom Nayagaon in Chhindwara District. It consists of only one member, *viz*, the limestone about 30 feet thick immediately underlying the Deccan traps without any visible unconformity, and resting unconformably on the metamorphics.

The limestone is highly porous and tuffaceous in character and shows signs of partial silicification. In places near the base there are patches of brecciated material containing irregular fragments of schist, quartzite, chert and ferruginous quartz.

Adjoining this exposure and separated from it by a fault-plane lies the characteristic Talchir succession composed of the fine sandstone with undecomposed felspars, the highly jointed pencil shales and the compact greenish and reddish mud-stones. There are no limestones overlying the Talchirs.

The Lametas as a rule are rarely fossiliferous and the few fossils that have been found are badly preserved and often indeterminable. The fossils hitherto reported consist of a few mollusca, fish remains and reptiles. All these come from the sandstones and clay beds, and no plant remains of any kind have hitherto been

noticed. Therefore the present find of a pretty well preserved flora from the limestones of Chhindwara is naturally of great interest and importance.

The plant fossils consist of impressions of leaves and fragments of fossil wood. There appears to be every possibility of fruits and seeds being noticed in the course of further studies. The flora as a whole appears to be in a state of fairly good preservation. All the leaves hitherto examined belong to the dicotyledonous angiosperms.

This is the first time that an undoubted angiospermous flora has been reported from the Lameta beds in India. The age of the Lametas as judged from the evidence of the fish remains has been considered to be Danian to lower Eocene, while the dinosaurian reptiles indicate a Turonian age. The evidence of the newly discovered plant remains may throw some light in determining the correct age.

The importance of this discovery to students of Indian Geology will mainly lie in: (*a*) the correct evaluation of the age of the Lametas; (*b*) the bearing it will have on the question of the age of the Deccan traps; (*c*) its being the first and the oldest angiospermous flora from India and the light that it may throw on the early angiosperms; (*d*) its usefulness in the recognition and correlation of Lametas from other regions; and (*e*) the incentive it will offer for further re-examination of the Lametas from other areas.

The description and identification of the fossil flora are under progress.

Univ. Dept. of Geology, Nagpur, SRIPADRAO KILPADY.

December 13, 1954.

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ENGINEERING PROPERTIES OF A LOAM SOIL FROM SIBPUR

IN continuation of the work[1] on the engineering properties of Indian soils, the physical characteristics of a loam soil collected from Sibpur (Howrah, West Bengal) have been determined. Similar studies have also been made after saturating this soil with aluminium because from physico-chemical considerations this treatment is expected to stabilise the soil. The methods used for determining the physical constants of the soil are the same as those described in the previous publication.[1] Determination of the base exchange capacity and of the exchangeable aluminium of the 'treated' soil indicated that the latter was 92·2 per cent. saturated with aluminium. The data obtained are given in Table I.

TABLE I

		Untreated soil	Treated soil
1	Grading (oven-dried basis):		
	(i) clay	.. 19·9%	
	(ii) silt	.. 41·1%	
	(iii) fine sand	.. 36·1%	
	(iv) coarse sand	.. 2·2%	
2	Apparent density	1·29	1·31
3	Moisture content at saturation	41·8%	41·9%
4	Volume expansion	7·1%	6·4%
5	Field moisture equivalent	25·6%	28·0%
6	Lower liquid limit	35·5%	37·0%
7	Plastic limit	30·0%	29·2%
8	Plasticity index	5·5%	7·8%
9	Shrinkage limit	25·4%	27·6%
10	Permeability coefficient	$6{\cdot}3\times10^{-4}$	$1{\cdot}0\times10^{-4}$

It will be seen that the permeability of the soil has been greatly reduced as a result of the treatment. This property along with the fact that the volume expansion is also reduced on saturating the soil with aluminium seem to attribute a higher 'water-stability', *i.e.*, against the disintegrating action of water, to the 'treated' soil. This is substantiated by the observation that an air-dried ball made from the untreated soil disintegrated completely into fragments in 23 minutes when placed in distilled water while 93 per cent. of a similar ball made from the treated soil remained intact under these conditions.

A comparison of the numerical values of the physical constants of the soil with those of the different groups[2] suggests that the Sibpur soil belongs to the A-4 group. From a consideration of the group properties of the soils, it appears that Sibpur soil is fairly suitable for foundation work and also for dam construction and as fill material after stabilization by densification. This soil may form stable road when dry but will soften under wet conditions. The 'aluminium-treated' soil seems to possess better properties for this purpose.

Bengal Eng. College, Sibpur, Howrah, B. CHATTERJEE.

October 10, 1954.

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KETO-ACID FORMATION IN MOULD CULTURES

THE formation of keto-acids like pyruvic, dimethylpyruvic, and α-ketoglutaric acids from glucose and other substrates by *Aspergillus niger* and *Penicillium chrysogenum* under certain cultural conditions, has been described by a number of investigators.[1-4] One of us (K. R.) in the course of investigations into the mechanism of formation of itaconic acid from sugars by *Aspergillus terreus* observed the formation in the culture solutions of substances which yielded derivatives with 2 : 4-dinitrophenylhydrazine, when the media contained small quantities of sodium arsenite. We have now examined several strains of *A. niger*, two strains of *A. terreus* (N.R.R.L. 255 and N.R.R.L. 1960) and one strain each of *A. wentii* and *A. oryzæ* and found that all these moulds yielded keto-acids when pre-formed felts of these, starved for a few hours, were allowed to float over media containing 0·01 M sodium arsenite in 0·1 M phosphate buffer (pH 7·8). The keto-acids were present in the culture solutions from 12-48 hours, after which they disappeared. They were identified by resorting to circular paper chromatography of their 2 : 4-dinitrophenylhydrazones, employing butanol-ammonia as solvent.[5] The R_f values of the keto-acid derivatives at 25°, using butanol saturated with 2 per cent. ammonia as solvent, were found to be 0·27, 0·56, 0·72 and 0·79 respectively for α-ketoglutaric acid, pyruvic acid, an unidentified keto-acid and dimethylpyruvic acid.

The addition of glucose to the buffer-arsenite media resulted in an increase in the formation of all the keto-acids, the acids being formed over a large number of days. Generally, pyruvic acid and in the case of citric acid—producing moulds, α-ketoglutaric acid also, increased to a large extent. The addition of glycerol to the medium resulted in slight increase in keto-acid formation. These keto-acids were also obtained when these moulds were allowed to float upon Hida's salts[2] containing glucose, although under these conditions considerably more of dimethylpyruvic acid and only traces of α-ketoglutaric acid were obtained as compared with arsenite-glucose media.

It was observed that when *A. niger* felts were floated over phosphate-buffer containing arsenite and either sodium lactate or sodium citrate, all the above mentioned keto-acids were formed, and lactate solutions gave more pyruvate compared to citrate solutions which gave more of α-ketoglutarate. We were also able to identify these keto-acids using this medium containing 2 per cent. dihydroxyacetone, although dihydroxyacetone in Hida's medium failed to yield any keto-acid and was only slowly metabolised. The replacement of the soluble sodium sulphite in the medium by the insoluble calcium sulphite also did not result in the formation of any keto-acid.

It was also found that the unidentified keto-acid[3] whose derivative had the R_f value of 0·72 which occupied a position on the chromatogram between the derivatives of pyruvic and dimethylpyruvic acids, was closely associated with pyruvic acid as the intensity of its band was often found to vary in proportion to the intensity of the pyruvate band. We also confirmed the observation of Seligson and Shapiro,[6] who described the appearance of two bands with the authentic pyruvic acid derivative under their experimental conditions. In our chromatograms, when the recrystallised pyruvic acid derivative, taken up in ethyl acetate, was used a main band at R_f 0·56 and often a faint band at R_f 0·72 were obtained. It is thus not clear as to whether the band at R_f 0·72 obtained from the culture solutions is only due to pyruvic acid itself or also due in addition to another keto-acid with that R_f value, though the latter appears not improbable. This matter is being further investigated using column chromatography. Work on a quantitative basis is also in progress and will be reported fully elsewhere.

Our thanks are due to Dr. S. Husain Zaheer for his interest in the work.

Central Labs. for Sci. & Industrial Research, Hyderabad-Dn.,
August 16, 1954.

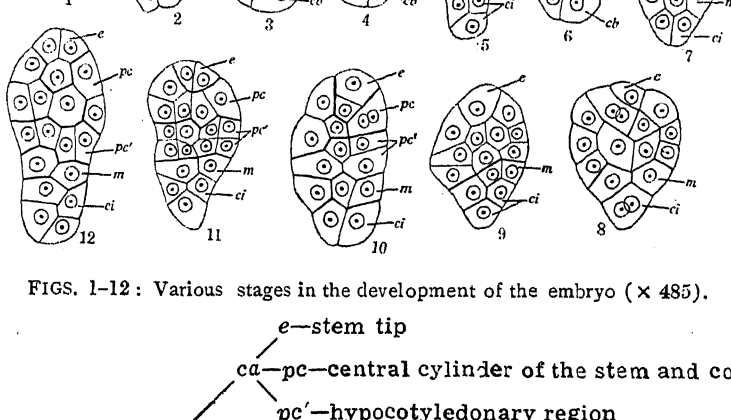
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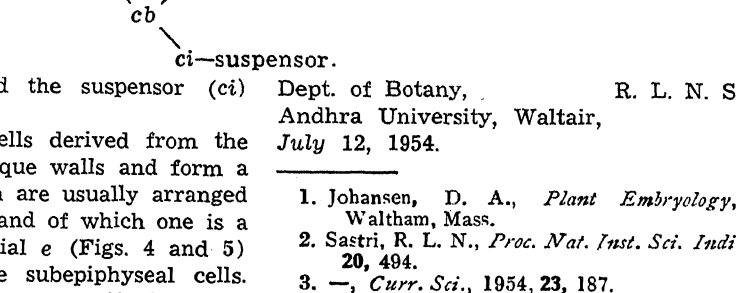
DEVELOPMENT OF THE EMBRYO OF *POLYALTHIA LONGIFOLIA* HOOK. f. AND THOMS.

THE development of the embryo has not so far been studied in any of the Annonaceæ. The present note describes briefly the development of the embryo of *Polyalthia longifolia* Hook. f. and Thoms.

The zygote divides transversely giving rise to two superposed cells, the apical cell *ca* and the basal cell *cb* (Fig. 1). Cells *ca* (Fig. 2) and *cb* (Fig. 3) divide each by an obliquely vertical wall. The derivatives of the basal cell by further divisions give rise to the hypo-



FIGS. 1-12: Various stages in the development of the embryo (× 485).



physeal region (*m*) and the suspensor (*ci*) (Figs. 5 and 7-12).

The two juxtaposed cells derived from the apical cell divide by oblique walls and form a group of four cells which are usually arranged in a tetrahedral manner and of which one is a triangular epiphyseal initial *e* (Figs. 4 and 5) and the other three are subepiphyseal cells. The epiphyseal initial does not divide till a late stage in the development of the embryo (Figs. 7-9). It then divides in various planes (Figs. 10-12) and forms the stem apex. The divisions in the subepiphyseal cells are rather irregular (Figs. 6-9). However, ultimately they give rise to two distinct tiers of cells: the upper *pc* forming the central cylinder of the stem and cotyledons and the lower *pc'* giving rise to the hypocotyledonary region (Figs. 10-12). The following scheme summarises the derivation of the various organs of the mature embryo from the proembryonic cells:

The embryo development of *Polyalthia longifolia* conforms to the Trifolium Variation of Onagrad Type.[1] The development of the embryo of *Tiliacora racemosa* Coleb.[2] and *Cocculus villosus* DC,[3] members of the family Menispermaceæ, studied by the author also conforms to the Trifolium Variation of Onagrad Type.

The author is grateful to Prof. J. Venkateswarlu for suggesting the problem and for his guidance.

Dept. of Botany, Andhra University, Waltair, *July* 12, 1954.

R. L. N. SASTRI.

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ACID/SALT CONTENT OF FIVE PRINCIPAL INDIAN VEGETABLE TAN MATERIALS

COMPREHENSIVE investigations including actual tanning tests have been carried out on five principal Indian vegetable tan materials, *viz.*, Babul (*Acacia arabica*), Goran (*Ceriops roxburghiana*), Sonali (*Cassia fistula*), Avaram

TABLE I

	Myrob.	Mimosa	Babul	Sonali	Goran	Avaram
	Before Tanning					
Acidity to pH 5·8 (mg. eq./litre):	75·0	3·1	3·8	1·7	9·5	4·7
Total salts (mg. eq./litre):						
(*a*) to pH 6·5 by resin method	25·4	22·0	57·3	101·0	79·0	74·0
(*b*) by sulphated ash method	29·1	27·4	49·0	112·0	..	79·0
Salts of weak acids (mg. eq./litre):						
(*a*) to pH 2·8	13·4	12·7	29·1	75·0	10·0	37·0
(*b*) to pH 2·0	26·0	18·1	46·6	94·0	15·0	48·0
(*c*) by alkalinity of ash method	31·5	..	1·01	111·0	79·0	63·0
Buffer Index	2·94	0·52	..	2·11	0·62	1·16
	After Tanning for six weeks					
Ammonium salts (mg. eq./litre) By modified method using phosphate buffer	0·3	1·1	1·4	0·5	1·0	0·7

(*Cassia auriculata*) and Myrobalans (*Terminalia chebula*) and the findings have been correlated with the chemical and physical characteristics of the leather produced. The subject has been approached from the angle of natural acid/salt content of these tan stuffs and detailed results will be published elsewhere. Several methods of approach including that of ion-exchange resins have been tried and their relative merits have been conclusively established. Some of the results are given in Table I.

From the above results as well as from the tiration curves obtained, it would appear that the tan liquors examined contain mostly salts of weak acids, and hence are more or less buffered. Calculations show that the average pH value of the acids naturally present in these liquors is 4.

The following conclusions may be drawn from a study of the determination of salts in the liquors by various methods: (*a*) the resin method is not a reliable indication of the total salt content; (b) the alkalinity of ash and titration to pH 2 methods are reasonably accurate for the determination of salts of weak acids; (c) the alkalinity of ash method may be unreliable in the presence of large amounts of chlorides and phosphates.

Central Leather Res. Inst., Madras-20, S. K. BARAT.*

November 16, 1954.

* The work was conducted at the Leather Industries Department, University of Leeds.

LIFE-HISTORY OF *HYDROCERA TRIFLORA*

Hydrocera triflora W. & A. is a monotypic member of Balsaminæ, the embryology of which is poorly known. The structure of the anther shows an epidermis and four layers of cells which surround the sporogenous tissue. The sub-epidermal layer differentiates out into the fibrous endothecium and the innermost layer immediately surrounding the mass of sporogenous cells forms the anther tapetum while ultimately the two middle layers become crushed. The behaviour of the anther tapetum is interesting. Early in the development of the anther, tapetal cells protrude into the sporogenous tissue and form trabeculæ which extend in various directions partitioning the sporogenous tissue into a number of small chambers (Fig. 1). The tapetal cells are at first 1-nucleate but later become 2- to 4-nucleate owing to one or two nuclear divisions in them. The division of the pollen mother cell is simultaneous and cytokinesis takes place by furrowing. Pollen grains are 2-nucleate at the shedding stage and have a thick exine with three germ pores (Fig. 2). The anthers are connate at the top and loculi of adjacent anthers fuse into a common cavity which contains the pollen grains derived from two half anthers (Fig. 3).

The ovary is five locular with three pendulous, tenuinucellate, bitegmic and anatropous ovules in each locule. The integuments are free from each other only for a small part of their length at the micropylar end of the ovule. The innermost layer of the inner integument forms the endothelium. The primary arches-

porium in the ovule consists of a single cell which elongates and directly becomes the megaspore mother cell without cutting off a parietal cell. An 8-nucleate embryo sac is formed according to the Allium type of development (Figs. 4 and 5). The synergids are without hooks. The antipodals are ephemeral and degenerate early. The polar nuclei fuse before fertilisation. The mature embryo sac is slender and very elongated.

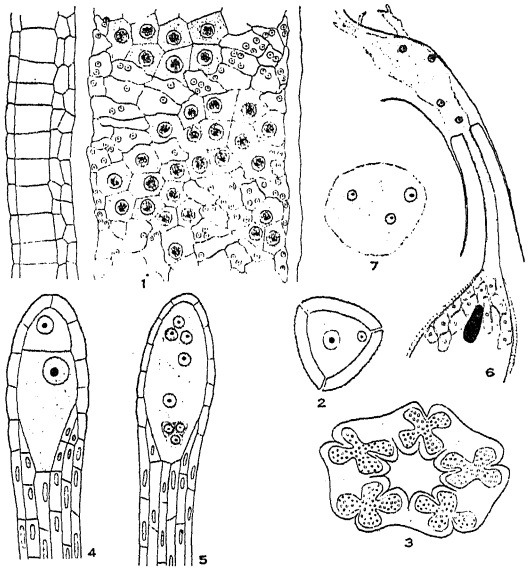
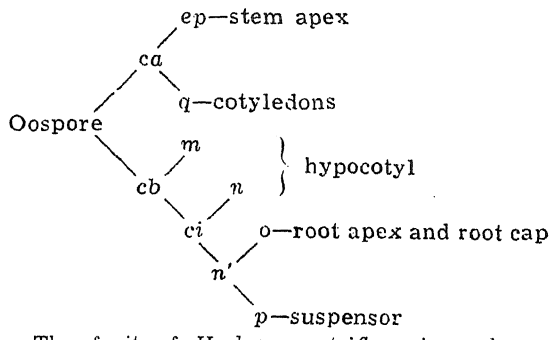


FIG. 1. L.S. of an anther lobe showing the sporogenous tissue separated into groups by sterile trabeculae like partitions, × 120. FIG. 2. Mature pollen grain, × 455. FIG. 3. T.S. of connate anthers showing 5 loculi each of which is formed by the union of 2 adjacent anther lobes, × 9. FIG. 4. Dyad, × 440. FIG. 5. 8-nucleate unorganised embryo sac, × 440. FIG. 6. Micropylar part of the embryo sac showing the multinucleate micropylar haustorium and the embryo surrounded by cellular endosperm, × 100. FIG. 7. Endosperm nodule, × 455.

Fertilisation in the species is porogamous. The endosperm is of the cellular type. The division of the primary endosperm nucleus is accompanied by cell-wall formation. Consequently the embryo sac becomes partitioned into a micropylar chamber and a chalazal chamber which is larger. Only free nuclear divisions take place in the latter. A feature of special interest is the formation of multinucleate endosperm nodules in this chamber (Fig. 7). The micropylar chamber undergoes a few transverse divisions and forms a uniseriate row of cells. The uppermost cell develops into a multinucleate branched giant haustorium the arms of which reach the funicle and even the placental tissue. The other cells by further divisions form a cellular tissue of endosperm which surrounds the embryo (Fig. 6).

The details of the development of the embryo are shown in the following schematic representation. It conforms to the Asterad type and keys out to the Erodium variation.



The fruit of *Hydrocera triflora* is a drupe. Only one seed is developed in each of the five locules of the ovary and the rest of the two ovules in each locule degenerate. The five seeds which are exalbuminous adhere to each other closely and give rise to what seems to be the 5-seeded stone.

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Dept. of Botany, L. L. NARAYANA.
Waltair, *September* 5, 1954.

CHROMOSOME NUMBERS IN *SACCHARUM SPONTANEUM*, L.

CHROMOSOME numbers have been recorded for a number of variants of *S. spontaneum*.[1-4] Akira Moriya[5] has reviewed the determinations made up to 1941; Parthasarathy and Subba Rao[6] have remarked that there is evidence of polyploidy in two series ($x = 8$ and $x = 10$) in the species. Certain aneuploids are also known to occur. The lowest chromosome number so far recorded[4] was $2n = 48$-50 and $n = 25$, and the highest[3] $n = 64$.

In the course of the work of the Spontaneum Expedition Scheme, haploid chromosome numbers have been determined for about 180 variants of *S. spontaneum* from aceto-carmine smears of pollen mother-cells. Of these, 150 are collections from within India and 30 are imported. The object of this letter is to record certain interesting numbers observed in some of the spontaneums collected. In four of the Indian forms, the number of bivalents has been found to be 20, which is the lowest so far observed in the species (Fig. 1). Two of them (SES. 199 A and 199 B) are collections from the Sunderbans area in West Bengal, the third (SES. 184 A) from Balasore District in Orissa and the last

(SES. 248) from Muzaffarnagar District in U.P. In five variants collected from the banks of the Krishna and Godavari rivers in Andhra State, 24 bivalents have been counted; this

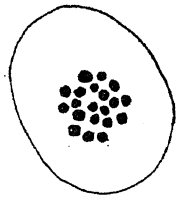


FIG. 1. Bivalents of *S. spontaneum* S.E.S. 1844×4·15

again is lower than the number recorded so far for the species. The variant Lahore[2] was found to have $2n = 48$, but later workers[7] have determined the number to be $2n = 54$ and $n = 27$.[6] Certain variants from East Pakistan have the meiotic numbers of $n = 26$, 27 and 28. The only number that had so far been known from this area was $n = 40$ in a form from Dacca.[6] The highest gametic number so far known for the species is 64 in one variant from Sumatra.[3] This number has now been found to occur in certain variants collected from four other countries, *viz.*, Ceylon, Uganda, Turkey and Egypt.

All the $n = 20$ variants are of the bushy, clump-forming, wiry-leaved type. The variants with $n = 24$ are also of the close, clump-forming type with slender stalks and wiry or narrow leaves. The East Pakistan variants are fairly tall, of medium girth and have medium leaves. The $n = 64$ forms vary considerably among themselves in growth form and width of leaves. The type from Egypt is bushy and wiry-leaved, while the Uganda forms are fairly tall and medium-leaved and the Ceylon variant is tall and broad-leaved.

Further details will be reported elsewhere.

Acknowledgements are made to Shri N. L. Dutt and Shri R. R. Panje for guidance and encouragement.

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SUBTERRANEAN CLEISTOGAMY IN *PHASEOLUS CALCARATUS*, ROXB.

AMONGST the *Leguminosæ* a few species have been reported upon as producing subterranean flowers (*Vicia amphicarpa, V. angustifolia, Amphicarpa monoica*[1] and *Voandzeia subterranea*[2]). To this group is now to be added *Phaseolus calcaratus* Roxb. which has been noted to produce such subterranean flowers (Figs. 1, 2 and 3). The species of *Phaseolus*

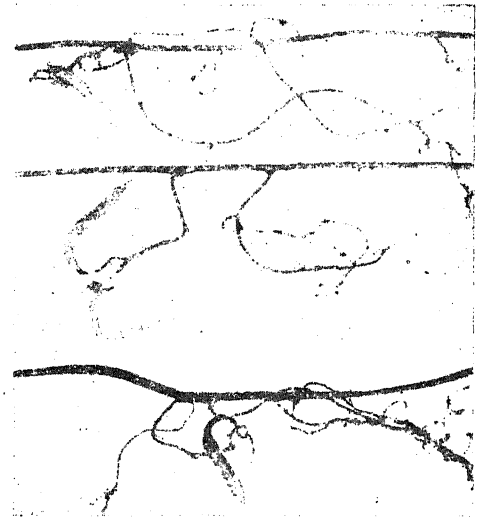


FIG. 1. Trailing branches showing subterranean flowers and pods; nodal roots with nodules.

calcaratus was collected from ever-green forests during the months of November-December, when they are in flowers. The plant usually grows in heavy shade, trailing along the ground and also twining up supports and producing branches and flowers off the ground. Those portions of the stem that trail on the ground in turn produce branches which become partially subterranean striking roots at nodes. From the axils of such branches which trail along the ground, short shoots are noticed to form one or two nodes and end in an inflorescence which becomes completely subterranean. These underground flowers on examination were found to be in no way different from the normal ones that are produced on the aerial



FIG. 2. Subterranean inflorescence showing a bud.

branches (Figs. 2 & 3). The anthers contain free pollen. Pods resembling the aerial ones were also observed with well set seeds. These pods were buried about two inches deep in the humus soil.

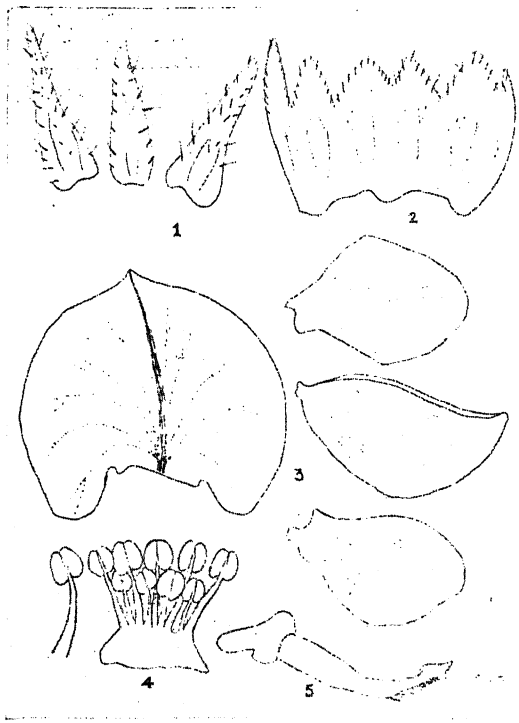


FIG. 3. Subterranean flowers dissected: 1. Bracts, 2. Calyx, 3. Petals, 4. Staminal Column (9 + 1). 5. Gynœcium, × 8.

This appears to be the first report in India of a species producing subterranean cleistogamic flowers in *Leguminoseœ*. If this trait is an inherited one, then the possibilities of utilizing this leguminous plant in meadows is worth a trial, similar to subterranean clover. The plants produce a large amount of green leaf, fairly good number of root-nodules and are tropical in distribution. A more detailed account of this species will be reported elsewhere.

Cytogenetics Lab.,
Agric. College & Res. Inst., D. KRISHNASWAMI.
Lawley Road, Coimbatore, N. KRISHNASWAMY.
September 17, 1954.

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SIGNIFICANCE OF THE ORBITO-TEMPORAL REGION IN THE SKULL OF THE SMALL BATS OF AJMER

THE structural modifications in the cranium of *Rhinopoma h. hardwickei* and *R. kinneri* illustrate how local conditions induce differences which may have a systematic value. They were procured from two different environments, *viz.*, an ancient Fort of Taragadh (2,500' above the sea-level) and the old monuments of the town respectively. The orbito-temporal region of these mammals show several features found only among reptiles, *e.g.*, the reduction of the cranial wall between the orbits and the orbito-temporal confluence.

In *Rhinopoma h. hardwickei* Gray. (Fig. 1), no tubercles or crests at the junctions of the

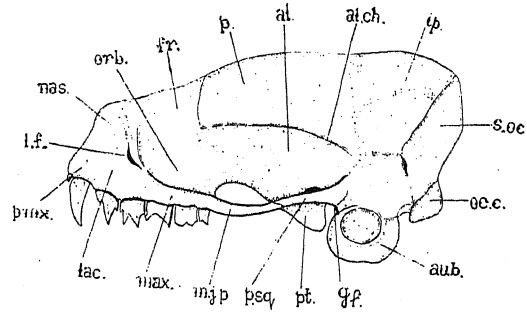


FIG. 1. Lateral view of the skull of *Rhinopoma hardwickei hardwickei* Gray. (× 12).

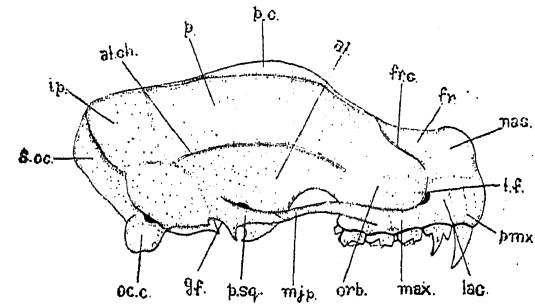


FIG. 2. Lateral view of the skull of *Rhinopoma kinneri* (× 12).

ABBREVIATIONS

al., alisphenoid; *al. ch.*, alisphenoid channel; *aub.*, auditory bulla; *fr.*, frontal; *fr. c.*, frontal crest; *g.f.*, glenoid fossa; *ip.* interparietal; *l.*, lacrymal; *lf.*, lacrymal foramen; *max.*, maxilla; *m.j.p.*, maxillojugal process; *nas.*, nasal; *oc.c.*, occipital condyle; *orb.*, orbit; *p.*, parietal; *pc.*, parietal crest; *pmx.*, premaxilla; *p.sq.*, postglenoid process of the squamosal; *pt.*, pterygoid; *s.oc.*, supra occipital.

parietal and the frontal have been observed. Dobson[2] in his monumental work on the Asiatic Chiroptera recorded that in *Rhinopoma* there is lateral and vertical extension of nasals, and that the frontal bones are depressed posteriorly

forming a shallow concavity in the forehead. However, in this specie although the nasals are laterally extended yet no depression and concavity of the frontal exist. The jugal is in continuation of the maxilla.

In *Rhinopoma kinneri* (Fig. 2) the parietal and the frontal lines are paired, but no sutural or otherwise lateral lines are used to separate them. At the mid-dorsal aspect, there are prominent tubercles, assigned as the parietal and the frontal crests respectively. The frontals are noticeably concave reducing the width of the cranial wall in the region of the orbit. Frank[1] correlates this feature as due to the feeding habits and the accommodation of the large eyes. However, the generic observations made in *Rhinopoma mycrophyllum* by Dobson[2] coincide with those of *R. kinneri*. The jugal is continuous with the maxilla only superficially as the maxillary teeth are visible ventrally.

These observations show that variations can exist in closely related species.

My thanks are due to Dr. P. N. Mathur for his kind guidance and help and Principal V. V. John for providing full facilities. I am also thankful to Shri Jagdish Prasad for his assistance and suggestions and to the Government of Ajmer for the award of a research scholarship.

Zoology Department, B. L. GARG.
Govt. College, Ajmer,
September 28, 1954.

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OCCURRENCE OF *SCYTONEMA* SP. IN THE LIGNITE OF KASHMIR VALLEY

A SAMPLE of lignite collected from a thick seam exposed between Nichahom and Lokut Dardhaj (altitude about 6,000′) in the Karewa beds of the Handwara area, Kashmir State, yielded a few pieces of *Scytonema* besides a great number of fern sporangia, spores, coniferous spores and woods. Iyengar and Subrahmanyam[3] have identified several types of fossil diatoms from the Karewas of Kashmir. Excepting this, the author has not come across any published record of fossil algæ from the Karewas and of fossil blue green algæ from India or abroad. The present discovery of the blue green algæ is, therefore, very interesting. It affords evidence of the existence of present-day flora in the Karewas of Kashmir and further strengthens the interpretation put forward by Sahni[4] that the Karewa beds are richly fossiliferous *lake deposits.*

A good and well preserved specimen of *Scytonema* (Fig. 1) described here has the following dimensions: trichome 10·5 μ–14 μ; cell ca. 13·1 μ; and sheath ca. 0·9 μ.

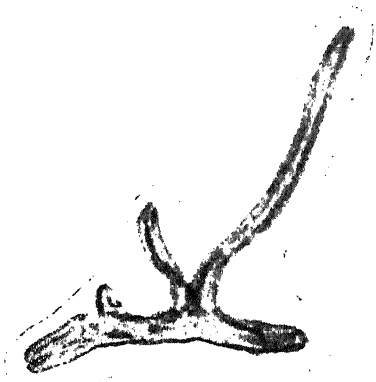


FIG. 1, × 426.

The specimens showed no heterocyst and appear to be in young stages, as according to Bharadwaja,[1] "Heterocysts are found only in older filaments, being absent from very young ones". The preservation of trichome with firm sheath and false branches confirms the presence of Myxophyceæ in the Karewas of Kashmir. Fritsch has stated, "Our knowledge of fossils Myxophyceæ is scanty and their assignation to this class for the most part very questionable. The two characteristics that might render a definite reference of a fossil form possible, *viz.*, the firm sheaths often enveloping the trichomes and the heterocysts, have nowhere, so far as I am aware, been recorded".

The specimen in question definitely confirms one of the two characteristics as laid down by Fritsch[2], *viz.*, the presence of a firm sheath around the trichomes. A detailed account will be published elsewhere.

The author thanks Professor K. R. Mehta of the Banaras Hindu University for help and guidance and Professor M. O. P. Iyengar for confirming the identity of the material.

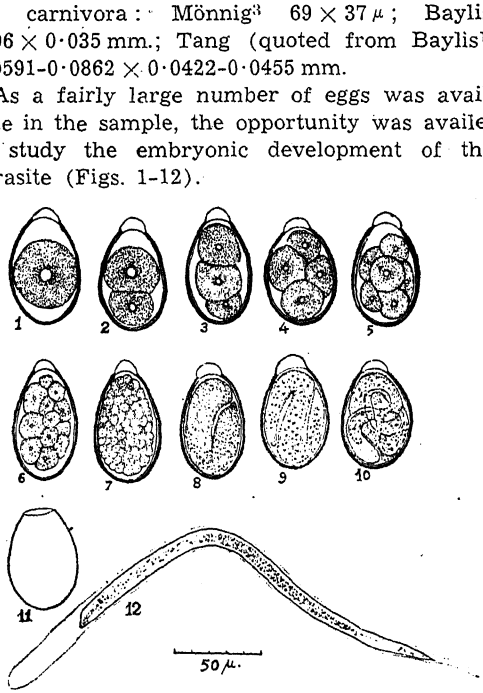
Dept. of Biology, S. K. GOSWAMI.
S. D. College, Saharanpur (U.P.),
October 1954.

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GNATHOSTOMIASIS IN A DOG

ON the 6th September 1954 a sample of stool from a small Nepalese dog was referred to the author for parasitological examination and opinion. The dog came to the out-patient clinic of Bihar Veterinary College for treatment with a history of dulness and abstinence from food. No other symptom was observed. Examination of a preparation made from this fæcal sample by ordinary sugar flotation method showed a large number of oval eggs which had a thin cap at one pole. The egg-shell was yellowish-green in colour and ornamented with fine granulations, which could be seen clearly only under oil immersion. These were in either one- (Fig. 1) or two-cell (Fig. 2) stage. They measured 60-68 × 37-42 μ. This measurement may be compared with those furnished for the eggs of *Gnathostoma spinigerum*, a parasite of several carnivora: Mönnig[3] 69 × 37 μ; Baylis[1] 0·06 × 0·035 mm.; Tang (quoted from Baylis[1]) 0·0591-0·0862 × 0·0422-0·0455 mm.

As a fairly large number of eggs was available in the sample, the opportunity was availed to study the embryonic development of this parasite (Figs. 1-12).



FIGS. 1 to 12. Camera Lucida Drawings of the Embryonic Developmental Stages of *Gnathostoma*.

Figs. 1 and 2. Eggs voided with fæces. Figs. 3, 4 and 5. 2nd day developments. Figs. 6 and 7. 3rd day developments. Fig. 8. 4th day developments. Fig. 9. 5th day developments. Fig. 10. 7th day developments. Fig. 11. Empty egg-shell left behind after the larva has escaped out. Note the absence of polar cap. Fig. 12. Free-swimming sheathed larva.

Mönnig[2] states that "Prommas and Dængsvang[4] found that the embryos became fully developed at room temperature in 8-10 days and hatched a few days later". The same author states later[3] that the eggs are passed in the one-cell or morula stage and hatch in the water in 4 days or longer.[5] In view of these conflicting statements the present observations are interesting.

As the dog is said to have been brought from Nepal *via* Calcutta, where it stayed for some time, it is difficult to throw any light on the source of infection. It is, however, the first case of Gnathostomiasis to have been detected in Bihar.

I am thankful to Sri. S. M. Hadis for kindly supplying the material which made this study possible and to Prof. S. A. Ahmad, for furnishing a description of the infected dog. Thanks are also due to Sri. D. N. Yadav, for his assistance in this work.

Livestock Res. Station, A. K. VARMA.
Patna, *September* 28, 1954.

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ON THE SECRETORY AND ABSORPTIVE ACTIVITY OF THE MIDGUT OF *PERIPLANETA AMERICANA* LINN.

DURING an investigation on the midgut epithelium of *Periplaneta americana* Linn., it was revealed that the secretory granules were discharged into the lumen of the midgut in a merocrine manner in specimens fed after a month's starvation (Fig. 1), and in both holocrine and merocrine manner in some specimens collected from nature and presumably feeding normally (Fig. 2). In the resting epithelial cells of the specimens starved in the laboratory no secretory granules or absorbed food material were present, and the cells presented a flat surface towards the lumen (Fig. 3). The absorption of food however appeared to be carried out both by the younger as well as older cells, and both the secretory granules and absorbed food material were observed together in the same old cell (Figs. 1 and 2).

Similar investigations carried out by previous workers[1-3] gave results different from the present results. Woodruff[3] did not describe any

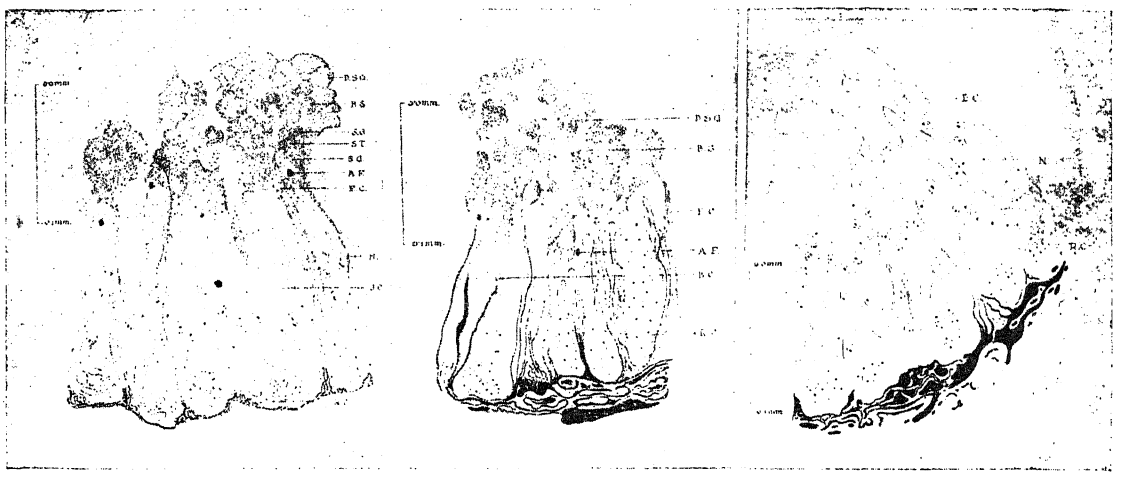


FIG. 1 FIG. 2 FIG. 3

FIG. 1. T.S. midgut *Periplaneta americana* Linn., fed after a month's starvation, part magnified showing merocrine activity.

FIG. 2. T.S. midgut *Periplaneta americana* Linn., collected from nature, part magnified showing both holocrine and merocrine activity.

FIG. 3. T.S. midgut *Periplaneta americana* Linn., starved for a month, part magnified.

A.F., absorbed food; B.C., broken cell; B.S., ball of secretory granules; D.S.G., discharged secretory granules; E.C., elongate cell; F., food in lumen; N., nucleus; P.M., periotrophic membrane; R.C., replacement cell; S.G., secretory granules; S.C., short cell; S.T., swollen tip of cell.

holocrine type of secretion in *Melanoplus*. Gresson[1] recorded that in *Periplaneta orientalis* L. the younger cells were at first engaged in absorption and later took to a secretory function and that the older cells contained only the secretory granules and did not have any absorptive function. Shinoda's[2] observation that in orthoptera a holocrine secretory activity resulted when the meal followed a period of fasting was a great deviation from the conditions prevailing in the present specimens, where the secretory activity in the case of individuals fed after long periods of fasting remained only merocrine (Fig. 1). The holocrine activity was observed in the older cells in the case of normal individuals collected from nature and presumably getting regular diets (Fig. 2); this indicated that the older cells after repeated secretory activity became weak and changed to a holocrine mode of secretion. The suggestion of Woodruff[3] that the changed conditions of the epithelial cells during the secretory activity might be artifacts resulting from the action of fixatives was not supported by the present observations. Pieces of midgut epithelium collected from starved and fed individuals and treated with same fixative revealed a clear change in the shape and contents of the cells due to the accumulation of secretory granules in them (Figs. 1 and 3).

I am greatly indebted to Prof. M. B. Lal for the supervision of work.

The detailed paper will be published later.

Dept. of Zoology, R. P. SRIVASTAVA.
University of Lucknow,
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GOLGI APPARATUS IN *AMOEBA VERRUCOSA* EHRENBERG

NASSANOV[1,2] showed that in protozoa possessing simple contractile vacuoles (*e.g., Vorticella*), the contractile vacuole wall gets deeply impregnated by Golgi methods of preparation, both in systole and diastole; while in others with complex vacuoles (*e.g., Paramecium*), in systole the impregnated wall of the reservoir is small and darkly stained; and in diastole, the canals are ringed and the reservoir is large and lightly impregnated. This impregnation in all cases is, however, very definite, limited and intense. Nassanov concluded that the "membrane" so impregnated, secreted or excreted the fluid found in the contractile vacuoles at diastole. Brown,[3] on the other hand, working on *Amœba proteus*, showed by a modified Bowen's acid

fuchsin-thionin-aurantia method after fixation in Champy's solution, that the Golgi apparatus consists of globules and spherules with clear centres and dark rims. These globules he compares with hypertrophied Golgi (globules) of metazoan cells. He interprets the formation of the contractile vacuole in *Amœba* by a union of the minute vacuoles which are associated with the crescent-like Golgi bodies.

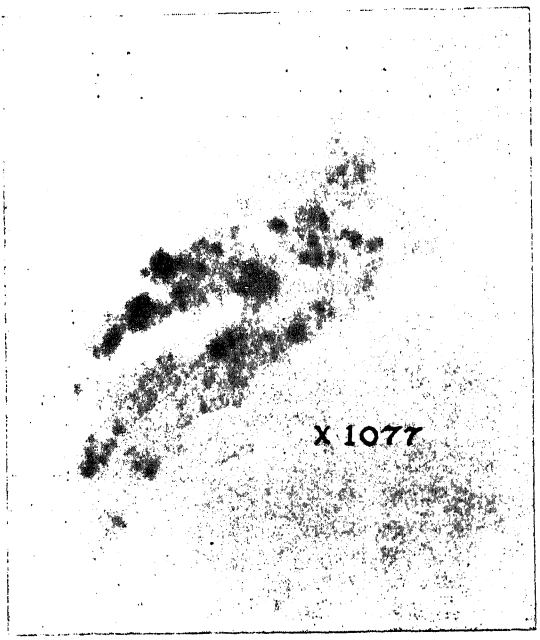


FIG. 1

By fixing specimens of *Amœba verrucosa* in Champy's fluid for 12 hours and staining by fuchsin-thionin-aurantia method[3] at Lucknow, we found *three types* of impregnated bodies (Figs. 1 and 2) which may be interpreted as Golgi bodies. They are: (1) dark solid granules which are distributed throughout the endoplasm; (2) small *vacuoles* (which are also distributed throughout the endoplasm) with a circular or crescent-shaped dark rim around each; (3) a few (3 or 4) large vacuoles (about one-third the size of the contractile vacuole at diastole) with fainter colour, but distinct from the other cytoplasmic inclusions.

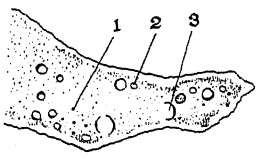


FIG. 2 A part of *Amœba verrucosa* Ehrenberg to show Golgi bodies (×750).

Contrary to Brown's interpretation we believe Type 1 to be the earliest phase of the Golgi body. Type 2 depicts the beginning of functional activity when the Golgi particles secrete small vacuoles and thus come to lie on the periphery, first as a crescent and then as a complete encirclement. Type 3 is difficult to interpret except by holding the view that the vacuoles are now larger and activity is about to cease. Apparently, it is in Type 3 that coalescence takes place and a fully formed contractitle vacuole makes its appearance. There is little doubt that although no formative vacuoles have ever been demonstrated in *Amœba*, the large contractile vacuole can only make its appearance by the union or coalescence of small vacuoles, since no stained rim has ever been found round the main contractile vacuole after application of Golgi methods. To our knowledge this is the first demonstration of the possibility of such a method of formation of the contractile vacuole in *Amœba*.

Besides, we find that contrary to Nassanov, *Amœba*, which has a simple contractile vacuole, does not show the impregnation in systole and diastole both.

Finally, the comparison by Brown of the round small vacuoles to hypertrophied metazoan Golgi in the secretory cycles, does not arise, as Types 1 and 2 are definitely deeply impregnated and only in Type 3 do we find a slowing down of the Golgi activity in *Amœba*.

Zoology Dept., S. M. DAS.
Lucknow University, H. B. TEWARI.
October 4, 1954.

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EFFECT OF SUPERPARASITISM ON SEX-RATIO AND MORTALITY

IT is well known that the sex ratio of a parasite depends upon the number of parasite grubs that develop on one single host larva. Many previous workers have ascribed this phenomenon to the influence of food on the parasite, postulating thereby that the amount of food available has got a direct relationship with the proportion of male-female emergence.

In *Microbracon hebetor* Say., experiments were carried out with varying numbers of parasite grubs developing on a single full-

grown larva of *Corcyra cephalonica* that was supplied as host for the parasite grubs. The results obtained are given in Table I.

TABLE I

No. of parasite grubs per host	Adults bred		Mortality %	
	% of males	% of females	grub stage	prepupal stage
2	50·0	50·0	Nil	Nil
3	22·2	77·8	Nil	Nil
4	81·8	18·2	8·3	Nil
6	55·5	44·5	5·3	Nil
7	66·7	33·3	4·5	Nil
8	62·5	37·5	4·0	Nil
13	73·6	26·4	13·2	Nil
18	66·9	33·1	14·8	Nil
24	60·9	39·1	11·1	Nil
32	66·3	33·7	9·2	1·2

From the data given in Table I three facts emerge clearly: (*i*) up to an intensity of 8 parasite grubs per host larva the ratio of the female to the male is markedly variable, but beyond this number the range of variation diminishes and the percentage of male emergence tends to become more or less constant; (*ii*) in the cases studied, the percentage of mortality also appears variable up to an intensity of 8 parasite grubs per host, after which it is more or less constant; (*iii*) a direct relationship between the sex-ratio and mortality is indicated as the two correspond with each other for all practical purposes up to a density of 32 parasites per host larva.

The greater percentage of male emergence among the parasites and the constancy in the sex-ratio can be explained on the presumption that among the dying grubs there is a majority of female-producing ones. In other words, the male-producing grubs are more hardy while the female-producing ones are more susceptible to causes that bring about death, the result being that when there is a larger number of grubs on a single host, the increase in the death of the female-producing grubs keeps the percentage of males dominant as well as constant.

When the number of parasite grubs per host larva is smaller, say 4, mortality is evidently not due to shortage of food. When the intensity of parasitism increases, shortage of food also increases. A direct relationship between availability of food and sex-ratio has therefore been suggested by other workers. Table I, on the other hand, shows that mortality here remains more or less constant after a certain intensity of parasitism, and so it is concluded that the growing influence of food shortage is kept in check by some other factor which influences both mortality and sex-ratio. Shortage of food thus has no net effect on sex-ratio up to a certain intensity and very little afterwards.

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NEUROSECRETORY CELLS OF THE REPTILIAN BRAIN

THE occurrence of secretory cells in the vertebrate central nervous system and the hormonic nature of their secretions have attracted much attention during recent years (*vide* reviews by Scharrer *et al.*[1]). But knowledge about these cells in reptiles is somewhat meagre. The presence of neurosecretory cells in the nucleus paraventricularis and the nucleus supraopticus in the hypothalamus of the garter snake *Thamnophis* sp., has been described by Scharrer.[2] These cells elaborate a stainable material in granular form which is removed to the pars nervosa of the pituitary gland and also to the paraphysis through their long axons.

Selecting some representative South Indian forms, a study of the neurosecretory system of the reptiles has been recently started in this Department. The brains of *Lissemys punctata* (Bonn.) among the Chelonia, *Tropidonotus piscator* (Schneid.) among the Ophidia and *Calotes versicolor* (Daud.), *Riopa albopunctata* Gray, and *Hemidactylus brooki* Gray among the Lacertilia were used for study. Freshly dissected brains fixed in Bouin's or Helly's fluid and sectioned at 5 μ thickness, were stained in Gomori's chrome alum-haematoxylin-phloxin or Heidenhain's Azan.

In these forms there is a special concentration of neurosecretory cells in the diencephalon. These cells are characterised by their large size, enlarged nuclei and prominent nucleoli. The cytoplasm shows fine granules and blotches which are stained dark blue. Such cells of the diencephalon occur in two paired groups. Of these, the larger group forming the paraventricular nucleus is located on either side of the diacoele towards the posterior part. The other group, the nucleus supraopticus, is more lateral in position and situated just above the optic tract.

Dark blue granules, similar to those seen in the cytoplasm of the secretory cells, have been noticed in the infundibular stalk, the pars nervosa of the pituitary and also towards the base of the paraphysis.

In addition to these neurosecretory centres of the diencephalon, concentrations of nerve cells with very prominent cytoplasmic content—suggesting the neurosecretory condition—have been observed in other parts of the brain. There is a median group of large cells in the midbrain, below the level of the optocoeles, and another group on the sides and floor of the iter. In the region of the medulla oblongata is a group of conspicuous cells which are of special interest, due to their distinctly larger size and intimate connection with the capillary bed (Fig. 1).



FIG. 1. Photomicrograph of three cells from the medulla oblongata of *Calotes versicolor* (Daud.)—Male. Sagittal section. Bouin and Gomori's chrome-hæmatoxylin-phloxin, × 700 approx. The colloids in the cytoplasm are seen as black patches and granules.

A detailed comparative study of the distribution of the neurosecretory cells in these and other reptilian brains, together with their cytology and histophysiology using the modern selective staining methods is in progress.

I am indebted to Prof. K. Bhaskaran Nair for providing facilities and to Dr. K. K. Nayar for suggesting this line of work.

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APHIDAE OF WEST BENGAL

THE family Aphidæ comprises one of the most formidable groups of insect pests, attacking practically all kinds of plants. They feed by sucking plant sap and cause appreciable damage thereby. But their importance as pests is greatly enhanced by the rôle they play in transmitting plant viruses, which they exhibit to a very high degree.

Little attention has been paid to this group in India. Besides the outstanding work of Das[1] on the Aphidæ of Lahore only a few contributions have been made to the knowledge of the Indian aphid fauna.[2-5]

The present authors have, for the first time, undertaken a systematic survey of the Aphidæ of West Bengal. Twelve species belonging to 8 genera have, so far, been identified. In this preliminary account a list of identified aphids and their host plants is appended herewith.

Aphis sp.—apple and pear; *Aphis craccivora* Koch.—bean, pea, pigeon pea; *Aphis gossypii* Glover—cotton, brinjal, bean, chillie, lady's finger, cucumber, bottle gourd, bitter gourd; ribbed gourd; pumpkin, water melon and canna; *Aphis nerii* B.d.F.—*Calotropis gigantea*; *Coloradoa rufomaculata* Wilson—cultivated chrysanthemum; *Lipaphis pseudobrassicæ* (Davis)—mustard, cabbage, cauliflower, raddish, beet, turnip, kohl-rabi, tomato and tobacco; *Macrosiphum* (*Sitobion*) *avenæ* (F.)—wheat, oat, barley, maize and millets; *Macrosiphoniella sanborni* (Gill.)—cultivated chrysanthemum; *Myzus persicæ* (Sulz.)—potato, mustard, tobacco and tomato; *Rhopalosiphum maidis* (Fitch)—wheat and barley; *Rhopalosiphum padi* (L.)—wheat and oat; *Toxoptera citricidus* (Kirk.)—lemon.

The authors acknowledge their gratefulness to Mr. J. P. Doncaster of the British Museum for the identification of the insects.

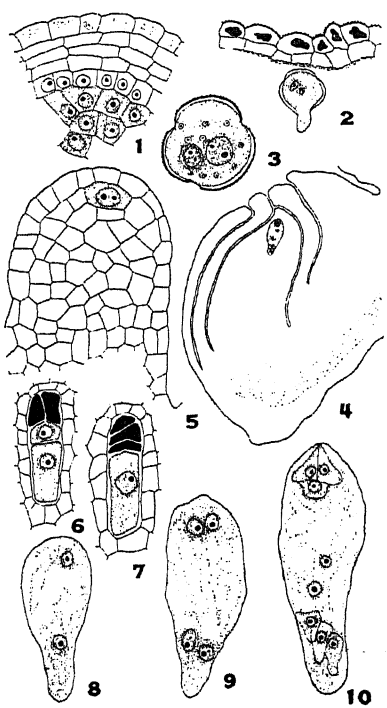
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Tollygunge, ADYANATH BASU.
Calcutta,
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GAMETOGENESIS IN *DILLENIA PENTAGYNA* ROXB.

Dillenia pentagyana, a tree growing in the Agumbe range of Western Ghats, in Mysore State, is the object of present embryological investigation. A study of literature reveals that information on the embryology of Dilleniaceæ is meagre; only two members having been investigated so far, these being *Hibbertia dentata* (Schnarf[1]) and *Wormia suffruticosa* (Paetow[2]).

The wall of the young anther is composed of four layers of cells external to the tapetum (Fig. 1). Tapetal cells are binucleate and they lose their contour very early. Stamens have terminal pores at the time of dehiscence. The wall at this stage consists of only epidermis and non-fibrous endothecium (Fig. 2). The microspore formation follows the simultaneous scheme, the separation of microspores taking place by furrows. The tricolpate pollen grains at the time of shedding are two-celled with smooth reticulate exine and contain small starch grains (Fig. 3). Occasionally they germinate *in situ* (Fig. 2).



FIGS. 1–10

FIG. 1. T.S. of young anther, × 334. FIG. 2. Structure of anther wall at dehiscence, × 334. (note the germinated pollen grain). FIG. 3. Mature pollen grain, × 500. FIG. 4. T.S. of an ovule, × 67. FIG. 5. T.S. of ovule with primary archesporial cell, × 334. FIGS. 6, 7 'T'-shaped and linear tetrads, × 334. FIGS. 8, 9. Two and four-nucleate embryo sacs, × 334. FIG. 10. Mature embryo sac, × 500.

Ovary is superior, five-loculed, five-carpelled, each containing many anatropous or amphitropous bitegmic ovules (Fig. 4). The carpels are coherent with one another only at the region of the axis. The hypodermal archesporium is differentiated in the young nucellar primordium (Fig. 5). The deep-seated megaspore mother cell undergoes meiotic divisions to form 'T'-shaped or linear tetrads of megaspores (Figs. 6, 7). The former type of tetrad is however more common. In either case the chalazal megaspore functions while the other three degenerate. The nucleus of the functioning megaspore undergoes three successive divisions resulting in an eight-nucleate embryo sac of the polygonum type (Figs. 8-10). *Wormia suffruticosa* also shows a similar mode of development. The mature embryo sac is small in size, broad at the micropylar end and narrow at the chalazal end. The polar nuclei usually meet in the centre of the embryo sac. The antipodal cells are in the narrow chalazal end and are ephemeral.

My grateful thanks are due to Professors L. N. Rao and C. V. Krishna Iyengar for their kind encouragement and valuable help. I am indebted to the authorities of University of Mysore for the award of a Research Fellowship.

Dept. of Botany, Central College, Bangalore-1, *November* 29, 1954. A. NAGARAJA RAO.

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OCCURRENCE OF *SPHACELOTHECA MCALPINEAE* ZUNDEL ON *HETEROPOGON CONTORTUS* L.

THE collection of fungi in the neighbourhood of Ajmer included an inflorescence smut on *Heteropogon contortus* L. during October and November when the infection was recognized by the long whip-like protrusion of the transformed inflorescence, 5-7 cm. long. Comparative studies indicate that the smut is *Sphacelotheca mcalpineæ* Zundel.

The smut destroys the entire inflorescence, the sori being covered in the early stages by the greyish-white membrane composed of the host cells and the false membrane of fungus cells. The false membrane later flakes away leaving the sterile cells intermixed with spore

mass exposed on the long protruding columella. Mature spores are reddish-brown in colour, 5·5-9·5 μ in diameter with a mean of 8 μ and smooth.

The spores germinate readily in water and nutrient solution, developing septate promycelium, the cells of which conjugate and produce the infection hyphæ. In the early stages of conjugation of the promycelial cells, the characteristic knee-bends may be observed (Fig. 1). While *Sphacelotheca monilifera* Ell.

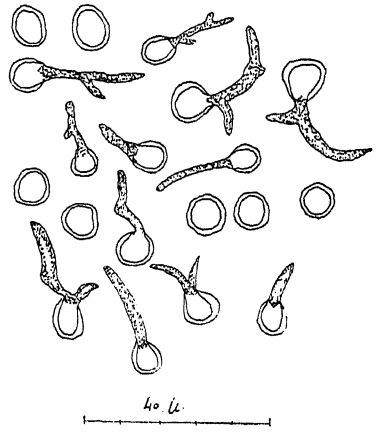


FIG. 1

& Ev.[1] has been reported by Thirumalachar from Nandi Hills, Mysore, and by Ajrekar from Kolas, Poona, Bombay, on *H. contortus*, there has been no previous record of *S. mcalpineœ* Zundel in India.

I am grateful to Dr. M. J. Thirumalachar for the identification of the fungus and Principal V. V. John and Prof. B. Tiagi for inspiration.

Dept. of Botany, N. C. JOSHI.
Govt. College, Ajmer,
November 16, 1954.

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THE STRUCTURE OF MITOCHONDRIA AND THEIR PROBABLE FUNCTION IN THE SUBMAXILLARY GLANDS OF THE SQUIRREL

GREAT confusion still prevails regarding the various cytoplasmic inclusions of the salivary glands of vertebrates, particularly their relation to the secretory products. The present note gives a summary of the structure and function of the mitochondria in the submaxillary glands of the Indian Palm Squirrel, *Funambulus palmarum* Waterhouse. To my knowledge this is the first contribution on the mitochondria in the Indian Squirrel. Small pieces of the submaxillary glands were taken in the living condition from the animal and were fixed by various classical fixatives for mitochondria, *e.g.*, Regaud, Zenker-Formol and Shridde. Shridde's method[1] involving the use

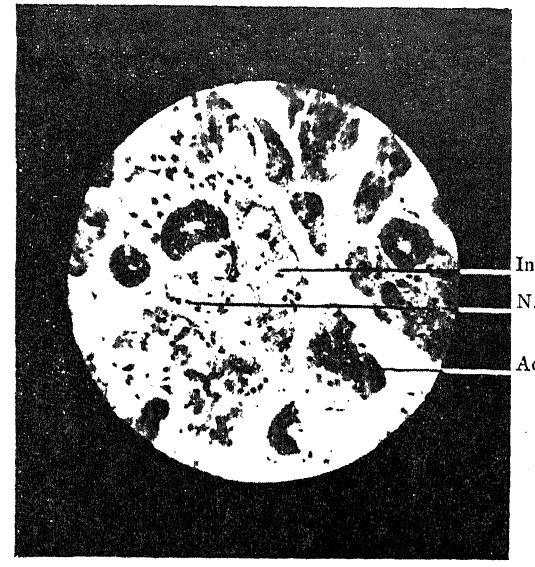


FIG. 1. Sections showing active cells (Ac.), inactive cells (In.), with prominent nuclei (N.), intralobular and interlobular ducts. (Shridde method, iron-alum-hæmatoxylin), × 100.

of formalin and potassium bichromate, followed by Muller's fluid and osmium tetroxide treatment, gave very good results. Sections cut at 3 μ were stained with iron-alum-hæmatoxylin. Mayer's mucicarmine stain used on sections fixed by Zenker-formol gave negative results for mucin.

Cells showing activity are always more important from the cytological point of view. In such cells mitochondria, lying on the side of each cell, away from the nucleus, are seen in the form of granules, and they begin their activity at spots bordering the secretory canaliculi (Fig. 2). In the initial stages they aggregate and arrange themselves to form ring-like structures with clear centres, the rim being composed of a single layer of mitochondria. In such clear centres, round, pale yellow albuminous bodies are elaborated by mitochondria. As the activity increases more mitochondria from the surrounding cytoplasm aggregate around the rings. The albuminous bodies also become bigger in size (Fig. 3). It may be pointed out here that the presence of potassium bichromate in the fixative preserves the albu-

minous material. After the elaboration of secretion products is over, mitochondria disperse and decrease in number. Then the albuminous products are extruded into the secretory canaliculi.

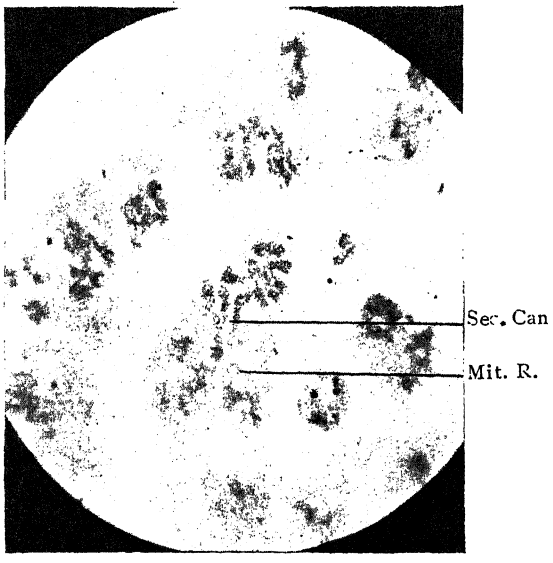


FIG. 2. Section showing groups of cells with mitochondrial rings (Mit. R.) near secretory canaliculi (Sec. Can.) (Shriddle method; iron-alum-hæmatoxylin), × 115.

Altmann,[2] Bouin,[3] Regaud and Mawas,[4] Hoven,[5] Arnold[6] and Maximow[7] were of the opinion that secretory bodies developed directly or indirectly from the mitochondria but later on Nassonow[8] followed by Bowen,[9] working on various glands, switched the opinion to the origin of secretory granules from Golgi bodies. However, Cramer and Ludford[10] in the thyroid have shown that during secretion both the Golgi bodies and mitochondria are enlarged. Duthie[11] working on the phenomenon of secretion of the salivary glands of rats and mice, is inclined to the view of the origin of secretory granules from mitochondria.

Heidenhain[12] examined the secretion collected from the submaxillary glands of the rabbit and found that it contained an albuminous substance instead of mucin. The present contribution has demonstrated the production of albuminous substances by mitochondria at actual spots of elaboration in cells. Upto this time generally filamentous type of mitochondria in various secretory glands have been described, but the present observations demonstrate the complete absence of the filamentous type of mitochondria in the submaxillary gands of

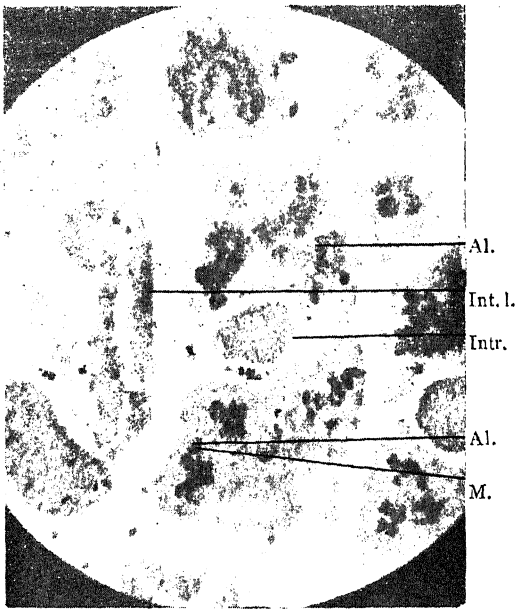


FIG. 3. Section through group of cells showing mitochondria (M) surrounding albuminous products (Al.), intralobular (Intr.) and interlobular ducts (Int. l.) (Shriddle method, iron-alum-hmœatoxylin), × 125.

the Indian squirrel. The detailed paper will be published elsewhere.

Dept. of Zoology, H. B. TEWARI.
The University, Lucknow,
November 4, 1954.

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REVIEWS

High Energy Accelerators. By M. Stanley Livingston. (Interscience Publishers, Inc., New York), 1954. Pp. 157. Price $ 3.25.

Particle accelerators have been playing a very important and spectacular part in the development of nuclear physics. The complexity and variety of these scientific instruments, or rather machines, are still on the increase. Though there are a few review articles and reports on conferences, there has been no book on the subject, and the present book is a good introduction to the field. The author, Prof. M. S. Livingston, has almost a life-time of association with the development of accelerators, from the days of the table-model cyclotrons of the 1930's to the multi-Bev. super machines of the future, of which he is a co-inventor.

The particle energy from present-day accelerators has reached such high values that even fixed frequency cyclotrons are not supposed to deserve a place among "high energy" accelerators. Consequently, electrostatic generators, Cockroft and Walton accelerators, cyclotrons and the like are not considered in the book.

The book is divided into seven chapters, and a list of important references is added at the end. Chapter I, "High Energy Accelerators as Tools for Nuclear Research", briefly deals with fundamental particles, their decay reactions, and the threshold energies for the artificial production of these particles. Chapters II-VI, dealing with the physical principles common to all accelerators, the electron synchrotron, the synchro-cyclotron, the linear accelerator, and the proton synchrotron respectively, are more or less elaborations of the author's article on "Particle Accelerators" ("Advances in Electronics", Vol. I, Edited by L. Morton, Academic Press Inc., New York, 1948, pp. 269-316). Chapter VII, "Alternating Gradient Focusing", discusses the multi-Bev. accelerators of the future, which are attracting widespread interest and study at the present moment. It is hoped that these machines will help to maintain the almost exponential rise in particle energy attained with accelerators during the past twenty-five years.

The book is not a "how-to-build-it" handbook, but an introduction to the vast literature scattered in journals and laboratory reports.

K. A. GEORGE.

Valves for A.F. Amplifiers. By E. Rodenhuis. (Philips Technical Library), 1954. (Distributors in India: Philips Electrical Co., Ltd., 7, Justice Chandra Madhab Road, Calcutta). Pp. viii + 147. Price Rs. 5.

There has been an increasing interest in recent years in high fidelity which is reflected in the many new designs of amplifier circuits and loudspeaker enclosures that have appeared in many countries. The publication of a book on suitable valves for audio amplifiers—as one of the popular series of the Philips Technical Library—is therefore to be welcomed.

The monograph will particularly be useful to the amateur radio enthusiast who is eager to design and construct his own equipment. To a lesser degree, the book will also be of interest to the manufacturer of professional equipment.

The first two chapters deal with general hints on amplifier construction and the characteristics of valves to be used in the different stages. The next two chapters describe some typical types of Philips valves that can be employed and give extensive performance data, together with hints on how such data could be utilised in practice. Circuit refinements such as negative feed-back, tone control, and special problems relating to output transformers, matching with microphones, pick-ups and loudspeakers, etc., are treated in the next chapter. The last chapter, comprising nearly half the book, gives complete description and data on eight amplifier circuits which include a wide variety from a 3 W gramophone amplifier to a 100 W amplifier for modulating amateur transmitters. In the appendix are tabulated data on valves, loudspeakers and electrolytic capacitors manufactured by Philips that could be employed in amplifier designs.

The aim of the book, in the words of the author, is to "enlarge the knowledge of the reader and to stimulate him to experiment for himself". Wisely, he cautions the reader that a "judicious designing of an amplifier demands a certain amount of knowledge, which is not gained by working to a blue print". Undoubtedly, the author has succeeded well within the limited framework he has set for himself and the book will be found invaluable to the radio hobbyist—who is still, unfortunately, all too rare in this country.

RAM. K. VEPA.

Chemical Constitution. By J. A. A. Ketalaar. (Elsevier Publishing Co., Amsterdam), 1953. Pp. viii + 400. Price 40 *sh.*

In his preface to the book, Prof. Ketalaar says that the volume provides the chemist "with a complement to the usual text-books of inorganic and organic chemistry, which will enable him to build up a great mass of data into a coherent body". One may differ from the author in places, and in some places there is a certain amount of obscurity of language through translation, but there is no doubt that the book will stimulate the reader and that the author has fairly succeeded in justifying his remarks.

There are five chapters in the book, starting with an introductory one on the periodic classification and the different types of chemical bonding, followed by one chapter for each type of bond. The author uses the term 'atomic bond' in place of the usual 'covalent bond', on the ground that this new term includes the one electron and three electron bond systems; but the same purpose can be achieved by not restricting the term 'covalent' to the shared electron pair system but to all systems where one or more electrons are shared, the commonest being the electron pair.

About eighty pages are devoted to a survey of the ionic bond in which the various physical properties receive attention. Dr. Ketalaar, however, leaves a few questions unanswered. In dealing with the question of the stability of the 'onium ion', how does he account for the fact that in the presence of water and hydroxylic solvents, the hydrogen ion is invariably solvated while phosphine shows very little tendency to associate with the hydrogen ion to form the phosphonium ion. In dealing with polysulphides, the analogy of the polythionates is used with tetrathionate as an example but, from chemical reactions, one generally takes the trithionate as the basis with branching of sulphur chains from the trithionate.

As may be expected, the chapter on the covalent bond occupies nearly half the volume. The chapter is a lucid account of the differing problems met with and gives a very useful comparative account of the molecular orbital and valence bond methods used in the studies. The metallic bond is introduced in a short chapter while the concluding chapter deals with the van der Waals' bond, of which the hydrogen bond takes up a good portion.

The volume is well produced and should find a place in every library where it should prove a useful book of reference to the advanced student. At the end of each chapter there is a valuable bibliography.

S. V. A.

The Physical Chemistry of Dyeing. Second Edition. By Thomas Vickerstaff. (Oliver and Boyd, London), 1954. Pp. 514. Price 42 *sh.* net.

The art of dyeing textile materials has been known to man since ancient times, but a systematic study of the fundamental principles governing the process of dyeing is of recent origin. There is no doubt that the recent progress in our knowledge of the structure of textile fibres has played a very important part in stimulating research in this branch of science. In this respect, the first edition of Vickerstaff's book on physical chemistry of dyeing was perhaps the first attempt to present a coherent account of the various adventures in this field of research.

The second edition of Dr. Vickerstaff's book is a revised and partly re-written version of the first edition.

In Part I of the book, a few additions have been made in the chapters dealing with purification of dyes, colloidal properties of dyes and dyeing equilibria, whereas in the chapter on kinetics of dyeing, the subject-matter has been brought up to date by inclusion of the work of Crank, Wilson and Standing. In Part II, the recent contributions on substantivity by Venkataraman and by Robinson have been included. In the chapter on direct dyeing equilibria, interpretations of the dyeing mechanism on the basis of surface and membrane potentials is dealt with in detail though the work of Goering and Mason is not included. The chapter on kinetics of dyeing has been considerably expanded and the interpretation of the dyeing mechanism based on Crank's mathematical treatment is fully described. A new chapter on the mechanism of dyeing cellulosic fibres with vat dyes, describing mostly the work from the I.C.I. Laboratories at Blakely has been added. The chapter on dyeing of acetate rayon has been expanded with the inclusion of relevant recent contributions and the portions dealing with the dyeing of protein fibres has been dealt with more exhaustively. A new chapter on the dyeing of polyester and other synthetic fibres has also been added.

The general make-up of the book remains essentially the same as that of the first edition. Most of the misprints and errors in the

first edition have been corrected. The author index has been considerably enlarged and all the latest contributions have been included. In all, 98 pages have been added. In spite of these additions, the price of the book is maintained at the old level. This revised edition should meet with even greater success than the first edition, and the author deserves the best thanks of those engaged in the study and practice of the dyeing process for his excellent book.

G. M. NABAR.

Survey of Research Problems in Plastics with Special Reference to the Development of Plastics Industry in India. (Council of Scientific and Industrial Research, New Delhi), 1954. Pp. 152. Price Rs. 5.

This is a general survey of chemistry of high polymers that would specially interest the plastics industry, and of the research work that is being carried out in various research laboratories in the country.

The first six chapters deal with the chemistry of natural and synthetic high polymers. The fundamentals of addition, radical and ionic polymerisations, poly condensations, various physical and chemical methods of determination of molecular weights of high polymers, thermodynamics and physical properties of high polymers have been very briefly surveyed. Natural resins or resin-like materials like rosin, bitumen, shellac, cashewnut shell and bhilwan shell liquids, polymers from naturally occurring cellulose, lignins, proteins, rubber are discussed. Polycondensation products—alkyds, amino resins, epoxy resins, phenolics, silicones, poly urethanes, poly oxymethylenes—are discussed. Polyhydrocarbons from ethylene, isobutylene, propylene, indene and all the vinyl type polymers, as well as acetylene polymers have been surveyed.

Each chapter ends with a list of research problems—fundamental, extension and developmental, particularly as they would pertain to India's needs of plastics industry. There is one chapter on processing of plastics which is well illustrated. The chapters on raw materials, specifications and testing, education in plastics and the present position of p'astics industry in India are very interesting both for the technologist and the high polymer chemist. This survey by the Plastics Research Committee of the Council of Scientific and Industrial Research has amply achieved its primary object of doing the spadework which must assist any co-ordinated programme of research or technology in plastics industry that might be undertaken in the future.

M. SANTHAPPA.

Chemical Engineering, Vol. I. (*Fluid, Flow, Heat Transfer and Mass Transfer.*) By J. M. Coulson and J. F. Richardson. (Pergamon Press, London), 1954. Pp. viii + 370. Price 38 *sh.* 6 *d.*

This is the first volume of a comprehensive book on "Chemical Engineering" designed to serve both university students and engineers in industry with an accent on the fundamentals of the subject. It has been divided into four sections: (*a*) fluid flow, (*b*) heat transfer, (*c*) mass transfer, and (*d*) humidification. The first three chapters are treated in a highly logical manner and are designed to provide an ideal basis for the detailed discussions on unit operations to be presented in the second volume of this work.

There is a short and useful chapter on units and dimensions where the C.G.S. and F.P.S. systems are compared. However, it is felt that more space could have been devoted to dimensional analysis. The fluid flow section begins with a study of energy relationships from a thermodynamic basis, leading on to flow conditions in pipes and channels with a particularly good mathematical treatment of compressible flow, critical pressure ratio and maximum discharge. The chapter on flow measurements discusses in detail the principles underlying the operation of all the usual types of flow meters. Pumps for chemical works are treated descriptively except for those amenable to mathematical analysis, such as centrifugal pumps and reciprocating compressors. For a book of this type, it would have been better if the design of vacuum pumps and ejectors had also been included.

The section on heat transfer follows the usual treatment of conduction, convection, radiation, boiling and condensation. Of particular interest is the discussion on heat transfer in reaction vessels with jackets and coils. In the section on mass transfer, after a very clear chapter on diffusion and the fundamentals of mass transfer, the relationship between momentum, heat and mass transfer is well treated. The last section deals with humidification and water cooling and the design of equipment for the same.

A very welcome feature of this book is that every section is provided with an extensive and uptodate bibliography. There are also worked examples to illustrate the application of theory to practical problems. The charts and figures are excellent and there are numerous tables of physical properties and other useful data. On the whole, this is a well written and well printed book, produced at a comparatively

low cost for the wealth of information included. The second volume would undoubtedly be eagerly awaited by all who have perused the first volume. M. G. SUBBA RAU.

The Charnockite Problem. By C. S. Pichamuthu. (Mysore Geologists' Association, Bangalore), 1953. Pp. 163. Price Rs. 5.

Ever since the recognition of the charnockites as a distinct rock suite by Sir Thomas Holland in 1900, they have been studied extensively by different workers in India and abroad. Opinions expressed with regard to their genesis have varied widely. B. Ramarao in his classical monograph on the charnockite rocks of Mysore reviewed ably the previous contributions and gave his own views from the results of his extensive field studies in the Mysore State. P. Quensel (1951) in his monograph on charnockites has given a fairly comprehensive summary of the more important contributions on charnockites.

The book under review, by Dr. C. S. Pichamuthu, which is based on his presidential address to the Mysore Geologists' Association in 1952 is somewhat distinctive in that, it gives a succinct account of our present state of knowledge of the charnockites and makes available most of the references of published papers as well as analytical data, on about 88 charnockites from different parts of the world.

The book is divided into several convenient chapters which will be found particularly useful for advanced students of geology and those interested in the study of these rock suites. Dr. Pichamuthu deserves to be complimented on this very useful compilation.

C. MAHADEVAN.

The Physiology of Insect Metamorphosis. By V. B. Wigglesworth. (Cambridge University Press), 1954. Pp. viii + 152. Price 12 *sh.* 6 *d.*

In this volume the author has given a critical analysis of recent advances in the study of the origin, nature and role of harmones in relation to growth and metamorphosis of insects. The last few years have witnessed a remarkable progress in our knowledge of the endocrine control of insect metamorphosis through the contributions of leading workers among whom the author is one of the foremost. No wonder Professor Wigglesworth has given a masterly account of the main trends in the advancement of a none too well known branch of zoology within the compass of a comparatively small volume.

The main thesis developed by the author is that insect growth and metamorphosis are controlled by the mutual effect of two principal harmones, *viz.*, a growth-promoting one inducing adult characters and another, the so-called 'juvenile' harmone responsible for larval traits. The maintenance of a balance between these two ensures normal growth and metamorphosis. Various aspects of such regulation have been discussed, and in support of the arguments advanced, convincing evidence has been presented from the investigations of the author as well as of other workers. From the position advanced above, the author develops the central theme of his work that the insect larva is as specialized as the adult and that the developing larva retains in it the potentialities for the larval as well as the adult pattern. The emergence of the particular pattern is dependent on the nature of the harmone influence. A corollary of the above conclusions is the idea suggested by the author of considering insect metamorphosis as an example of polymorphism.

The book is profusely illustrated and an exhaustive list of references is included. It should prove a valuable asset to research workers in this field besides providing interesting and instructive reading to all zoologists.

G. KRISHNAN.

Representative Chordates. By C. K. Weichert. (McGraw-Hill), 1954. Pp. viii + 204. Price $ 3.50.

Four vertebrate types, the Marine Lamprey, the spiny dog fish, the mud-puppy and the cat are described in detail so as to help the student who has to dissect and study the anatomy of a few chordates within a single quarter.

While this book commends itself to the student as well as to the teacher by its excellent and informative figures and the detailed instruction how to proceed with the dissection of the different systems, it is doubtful if it will be of much use to students in India. The types chosen for study are either not available in India or are not usually preferred for the courses prescribed. The Lamprey and the mud-puppy are not Indian; the chapters on the spiny dog fish and the cat may however be of general utility, since the shark and the rabbit studied in Indian Universities are not very different from them. Further, as courses in zoology are spread over 2 or 3 years in all Indian Universities, more types need to be included. Excellent as the get-up and treatment are, it is doubtful if the Indian student will purchase a copy of it at a cost of nearly Rs. 12.

C. P. GNANAMUTHU.

Books Received

Isotopic Gas Analysis for Biochemists. By R. F. Glascock. (Academic Press), 1954. Pp. viii + 247. Price $ 5.80.

Precision Laboratory Standards of Mass and Laboratory Weights. By T. W. Lashof and L. B. Macurdy. (NBS Circular 547, Washington 25 D.C.), 1954. Pp. 24. Price 25 cents.

Elements of Statistical Mechanics. By Bipin Kumar Agarwal. (Pothishala Ltd., Allahabad), 1954. Pp. 144. Price Rs. 6.

Cellulose and Cellulose Derivatives, Part II. Edited by Emil Ott, Harold Spurlin and Mildred Grafflin. (Interscience Publishers, Inc.), 1954. Pp. viii + 511-1055. Price $ 12.0.

Fluoridation as a Public Health Measure. Edited by James H. Shaw. (AAAS, Washington 5 D.C.), 1954. Pp. v + 232.

Thermal Conductivity of Metals and Alloys at Low Temperatures. By Robert L. Powell and Williams A. Blanpied. (NBS Circular 556, Washington 25 D.C.), 1954. Pp. 68. Price 50 cents.

Introduction to Theoretical Mechanics. By Robert A. Becker. (McGraw-Hill), 1954. Pp. xiii + 420. Price $ 8.00.

Analysis of Deformation, Vol. II. By K. Swainger. (Chapman & Hall), 1954. Pp. xxxvi + 365. Price 70 *sh.*

Luminescence with Particular Reference to Inorganic Phosphors. (British Journal of Applied Physics, Supplement 4). (Institute of Physics, London S.W. 1), 1955. Pp. iv + S 119. Price 25 *sh.*

Psychology of Invention in the Mathematical Field. By Jacques Hadamard. (Dovar Publications), 1955. Pp. xiii + 145. Price $ 1.25.

SCIENCE NOTES AND NEWS

A New Crystalline Silica

The existence and conditions of formation of a new crystalline form of silica having a characteristic structure and physical properties have recently been reported (*Science,* 1954, 120, 328).

The new silica crystals are very stable thermally—heating at 1,100° C. for 37 hr. showed little, if any, conversion to cristobalite. Differential thermal analysis also showed no inversions up to 1,100° C.

Optical examination of crystals up to 50 μ in size showed them to be uniaxial negative, with $\omega = 1{\cdot}522$ and $\epsilon = 1{\cdot}513$. The predominant habit is that of square platelets. Density was found to be 2·50. Single-crystal X-ray analysis yields a primitive tetragonal unit cell with dimensions a and c of 7·46 and 8·59 Å. These data taken together with the calculated value of density indicate that 12 formula weights of SiO_2 constitute the unit cell.

Cosmic Rays for Measurement of Land Masses

The first apparatus to put cosmic rays to practical use has been designed in Australia. It will be employed in construction work on the Snowy Mountains Hydro-Electric Project in New South Wales. It consists of a super geiger counter, which records the number of cosmic rays falling upon it. Readings will be taken at various points in a tunnel being excavated as part of the Snowy Mountain Project. By comparing the readings with the number of rays recorded outside, it should be possible to determine the density of the land mass above the tunnel. The use of the apparatus will result in an enormous saving of time and money, as it will eliminate drilling and sampling of the land mass.—UNESCO.

Chemical-Biological Co-ordination Centre, Washington

A chemical-biological co-ordination centre of the National Research Council has been set up in Washington, U.S.A., to provide accessible records of data relating chemical constitution to biological activity. The information, culled from both published and unpublished data, is recorded on data sheets and also on punched cards which can be mechanically sorted. The coding systems adopted enable all the recorded data in almost any defined field to be separated from the mass and a list of references prepared for the enquirer.

The facilities of the Centre are available to all *bona fide* enquirers in the U.S.A. and it is now desired to expand the contacts to include workers in the British Commonwealth. The Centre is prepared to accept enquiries from organisations in the Commonwealth: it will also be pleased to receive suitable material for inclusion in its records, particularly unpublished data or data published in relatively inaccessible journals.

Cortisone in Dermatology

The first report of the British Medical Research Council panel on the dermatological applications of A.C.T.H. and cortisone has been published in a recent issue of the *British Medical Journal* (*Brit. Med. J.*, Dec. 4, 1954, p. 1,307). It records their effect on various types of eczema and allied skin lesions, including Besnier's prurigo and exfoliative dermatitis.

In assessing the results, the report does not minimize the risks. Four deaths occurred, though they were not necessarily all directly due to the treatment, and psychological disturbances occurred in six; one of these patients had to undergo leucotomy. Other less serious consequences are also recorded. Though it is not specifically mentioned, one of the most distressing of these is relapse of the disease after treatment to a state worse than before.

Agar-Agar from Sea-Weeds

Shri G. B. Mohanty, Department of Fisheries, Orissa, reports a method for the manufacture of agar-agar from sea-weeds *Gracilaria lichenoides* and *G. confervoides* found abundantly in Chilka Lake, Orissa (*J.S.I.R.*, 1955, 14 A, 36). The product obtained has the following characteristics: moisture, 24·2 per cent.; acid insoluble ash, 0·16 per cent.; total ash, 2·7 per cent.; water absorption, 8·8 times its weight of water; and setting property, satisfactory for use in preparing bacteriological media. Except for its higher moisture content, the sample conforms to B.P. and U.S.P. standards. The higher moisture content, which might be due to faulty storage conditions, is of no serious consequence.

London 'Varsity Research Fellowships

The University of London is inviting applications for research fellowships offered by the Imperial Chemical Industries in Bio-Chemistry, Chemistry, Chemotherapy, Engineering, Metallurgy, Pharmacology, Physics or allied subjects, and for Turner and Newall Fellowships in Engineering, Inorganic Chemistry, Physics or an allied subject. The Fellowships will not be less than £ 750 per annum with family allowances and Federated Superannuation Scheme for Universities. The fellowships are tenable from October 1, 1955, for a period of three years in the first instance.

Applicants should have obtained a Ph.D. Degree or have a substantial record of research behind them. The applications should be addressed to the Academic Registrar, University of London, Senate House, W.C. 1, and should reach not latter than April 16, 1955. Further information and prescribed forms can be had from the same authority.

Royal Society and Nuffield Foundation Commonwealth Bursaries

Applications are invited for awards under the Royal Society and Nuffield Foundation Commonwealth Bursaries Scheme which was instituted to provide facilities for increasing the efficiency of scientists of proven worth by enabling them to pursue research, learn techniques or follow other forms of study in natural science or personal environment or both. The bursaries provide travel, maintenance at a rate of about £ 600 a year and are tenable usually for periods of 2-12 months. Fuller particulars and forms of application may be obtained from the Assistant Secretary, The Royal Society, Burlington House, London, W.1. Applications should be made before 15th March 1955 for proposed visits beginning during the period from July to December 1955.

STANVAC Oil Refinery

The STANVAC petroleum refinery which was formally declared open recently is the first of its kind in India, and is expected to turn out more than 300 million gallons of six different fuel products each year. These are (in million gallons): gasoline, 90; kerosene, 40; automotive diesel oils, 59; industrial diesel oils, 40; industrial fuel oils, 55; and bunker fuel, 45.

Award of Research Degree

The University of Poona has awarded the Ph.D. Degree in Chemistry to Shri Mattoo Brij Nath for his thesis entitled "Absorption and Fluorescence of Organic Compounds".

The University of Saugar has awarded the Ph.D. Degree in Botany to Shri S. B. Saksena for his thesis entitled "Ecological, morphological and taxonomical studies on soil microfungi of some forest soil types of Sagar", and to Shri K. K. Bhatia for his thesis entitled "Factors in the distribution of *Tectona grandis* Linn. (Teak) and a study of teak forests of M.P."

Indian Botanical Society

The following office-bearers were elected for the year 1955 at the Thirty-Fourth Annual General Meeting of the Society held at Baroda.

President:—Fr. H. Santapau, Calcutta.

Vice-Presidents: (1) Dr. R. K. Saksena, Allahabad; (2) Dr. B. P. Pal, New Delhi.

Hon. Secretary: Dr. R. Misra, Saugor.

Treasurer and Editor-in-Chief: Dr. T. S. Sadasivan, Madras.

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Editor: Prof. G. N. Ramachandran, A. C. College of Technology, Madras 25

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STATE SUPPORT AND RESEARCH

THE development of a modern laboratory, or even its operation at its normal level of activity, requires the expenditure of such large sums, that no scientific institution nowadays is in a position to meet this without financial assistance from the State. This state of affairs appears to be universal. For instance, 70% of the cost of research work done in the U.S. Universities is borne by the Federal Government, and runs up to 200 million dollars; about 50% of the student charges is also derived directly or indirectly from Government sources. In the United Kingdom, 65% of all the income of the Universities come from Parliamentary grants. In Germany, 90% of the expenditure for research is met by the State, and this is probably true also of India.

The problems raised as a result of such a predominant role of the State in the finance of scientific research were discussed at a Congress held in Hamburg in 1953, whose report has just been published.* The objectives of the Congress, according to Michael Polanyi, Chairman of the Organising Committee, were three-fold: to examine critically the organisation of scientific activity in various countries, with a view to reform and improvement; to give due and wide publicity to the nature and extent of suppression of intellectual freedom under totalitarianism; and to clarify the philosophical foundations of the idea of freedom as related to science.

* *Science and Freedom*—(Proceedings of the Hamburg Congress on Science and Freedom), Secker and Warburg, London, 1955, Pp. 292, Price: 21 *sh.*

Excluding the opening and closing sessions, the report is divided into five parts corresponding to the five sessions of the Congress which dealt respectively with: Organisation of Science, Science and the State, Science and its Method, Science in Chains, and Scientist and the Citizen.

The second session of the Congress considered in detail the problems mentioned above, namely, the political and economic framework required for the cultivation of independent scientific research in a free society. There was general agreement that the overwhelming role of the State in providing the finance for scientific research and for education in general is unavoidable. It is also obvious that even under the best set-up this would involve a certain amount of restriction of academic freedom. The discussions therefore mainly centred on the methods of reducing the centralised control to the minimum and providing the maximum freedom to the scientist and the intellectual.

It would be certainly wrong to say that science is nowadays delivered helpless into the hands of the State and its freedom destroyed, merely because it becomes dependent on the discretion of the State, exercised through its power to grant or refuse financial support. As Ludwig Raiser says, "Liberty can perfectly well be maintained in investigations supported by the State, so long as there are adequate guarantees that the State will respect the independence of the scientific domain, and of the methods of procedure appropriate to it, and will keep strictly to its role as protector and sponsor and not transgress into that of a dictator". The need for an authority constituted by the State, but composed essentially of academic people, who would be in charge of the distribution of funds for research is therefore obvious. The system adopted in England, where Parliamentary grants are administered by the University Grants Committee, was universally considered to be the ideal solution. It is indeed gratifying to note that this system has now been adopted in this country. It constitutes a relationship which presupposes mutual confidence and thus also implies the necessary freedom for both parties.

It would be appropriate to mention also another type of freedom which the academic worker must have, which was pointedly raised by Andrade. One of the results of the regimented organisation of research has been "in destroying the leisure of a professor. I would mention three words—committees, reports, correspondence. When I was young, they meant 5% of a physicist's time; now I leave it to you, gentlemen, whether it is 80%, 85%, 90% or 95%, but it is something like that.....Who is going to say in these days, 'I will keep this young man for the next ten years at leisure on the off chance that he will produce something?' But they did when I was young; perhaps once in three times they picked a dud, but the other two were the men who made advances in science".

The extent to which the State financing of research might react on the freedom of choice of subjects for research was also considered during the session. Tarski draws attention to the fact that while scientists, physicists and chemists in particular, have wide opportunities in the United States, philologists in general were at the bottom of the hierarchy until very recently they came greatly into demand with the development of the subject of mechanical translation. No solution appears to be in sight for this situation; it is bound to arise with any form of economic support. This whole issue of the material dependence of the scientist on the community is worthy of the most careful attention.

CONGRESS AND EXHIBITION AT FRANKFURT, 1955

THE Congress of the European Federation of Chemical Engineering, 1955, will take place in Frankfurt am Main from 14th to 22nd May, 1955, at the same time as the ACHEMA XI Chemical Engineering Exhibition and Congress. The Congress will be arranged in collaboration with all the member associations of the European Federation of Chemical Engineering.

More than 600 firms from 12 countries, will be presenting their new developments and established ranges of production for discussion in the Congress. Instruments for measurement and control to deal with the numerous variables of State and properties, with a degree of accuracy to meet the exacting requirements of modern science and technology, will be demonstrated by specialists from about 50 firms from 5 different countries. Individual lectures will be delivered during the afternoon and will deal with specific scientific observations and technical developments.

The ACHEMA XI Lecture Course will be organised by ACHEMA as an introduction for native and foreign students to the vast field of chemical engineering. Lectures will be held in the mornings followed by an inspection of various apparatus and machinery. The final programme for the Congress of the European Federation of Chemical Engineering will be sent to the members in due course.

Further details can be had from: Dechema, Frankfurt am Main, W-13, Germany.

AGE LEVELS OF ARCHAEAN STRUCTURAL PROVINCES

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FERMOR[1] chose the association of certain parts of Archæans with characteristic groups of sediments as a major criterion for the correlation of ancient schistose formations of Peninsular Archæans. In contradistinction to this approach, Krishnan[2] and Holmes[3,4] tried to arrive at the relative ages of the orogenies which had produced the characteristic regional strikes of the structural provinces of the Archæans (N.E.-S.W. for Aravallis, N.N.W.-S.S.E. for Dharwars, N.E.-S.W. for Eastern Ghats and E.N.E.-W.S.W. for Satpuras).

With the objective of dating the pegmatitic cycles of these provinces, detailed investigations were undertaken on five radioactive minerals drawn from various parts of Peninsular India—namely, Samarskite from Nellore (Andhra State), monazite from Mewar (Rajputana), and allanites from Madura (Madras State), Purulia (Bihar) and Anakapalle (Andhra State). Their physical and optical characters, autoradiographic pattern and chemical composition were studied to examine their suitability for purposes of age determination. While Samarskite has been found to be highly suitable,[5] allanites from Purulia and Anakapalle are fairly so but allanite from Madura[6] and monazite from Mewar are undependable as age indicators, as they have suffered leaching. The age data on the three suitable radioactive minerals determined by the lead-uranium-thorium method together with some recent Alpha-Helium and Rubidium-Strontium ages are given below:

No.	Name of the cycle	Name of the mineral dated	Locality of the mineral	Method of age determination	Age (in M.Y.)	Degree of dependability
1	Dharwar	Magnetite	Holenarsipur, Mysore	Alpha-Helium	1740	Satisfactory
2	do (?)	Phlogopite	Neyyur, Travancore	Rb-Sr	1630 ± 200[7]	do
3	Eastern Ghats	Samarskite	Nellore, Andhra	Pb-U-Th	1625 ± 75	Good
4	do	Allanite	Anakapalle, Andhra	do	1585	do
5	do	Magnetite	Mayurbhanj, Orissa	Alpha-Helium	1200	Satisfactory
6	do	do	Ongole, Andhra	do	1350	do
7	do	do	Salem, Madras	do	1350	do
8	do	Phlogopite	Visakhapatnam, Andhra	Rb-Sr	1490 ± 200[7]	do
9	Satpura	Allanite	Purulia, Bihar	Pb-U-Th	880	do
10	do	do	Bahea, Bihar	do	880[8]	do
11	do	Monazite	Pichchli, Bihar	do	970[9]	Good
12	do	Magnetite	Singhbhum, Bihar	Alpha-Helium	970	Satisfactory

In the above table, the apparent lead ages are read from the family of curves given by Wickman.[10] The ages termed "good" are dependable and those termed "satisfactory" are of the expected order of magnitude.

The Eastern Ghats cycle is given an age of $1,625 \pm 75$ M.Y. taking into consideration the magnitude of variations in the age data available. Holmes[3,4] has dated the Satpura (955 ± 40 M.Y.) and Delhi (735 ± 5 M.Y.) cycles and has recently given an age of $2,300 \pm 100$ M.Y. to the Yediyoor monazite belonging to the Dharwar cycle and $1,570 \pm 70$ M.Y. to detrital monazite from Cuttack District of Orissa (personal communication). All the four ages given above are highly dependable, being based on the isotopic analysis of lead. It therefore follows that the Eastern Ghats cycle is younger than the Dharwarian and older than those of Satpura and Delhi.

The age of the Travancore phlogopite ($1,630 \pm 200$ M.Y.) which occurs in the pyroxenite dykes is interesting. The occurrence of the mineral in the junction zone of Dharwar and Eastern Ghats strikes and the general strike of the associated charnockites and leptynites (N.N.W.-S.S.E)[11] have rendered it difficult to place the mineral in either Dharwarian or Eastern Ghats structural province. As the phlogopite from Visakhapatnam belonging to undoubted Eastern Ghats province has given an age of $1,490 \pm 200$ M.Y. and in view of the fact that the strike of the formations associated with the Travancore phlogopite is more closely related to Dharwarian rather than that of the Eastern Ghats, it is suggested that the phlogopite may belong to the Dharwar cycle.

The quartz-magnetite rocks of Ongole and Salem belong respectively to Madras-Ongole Province (No. 12) and Salem-Arcot Province (No. 11) of Fermor.[1] Both of them belong to the iron-ore province of the charnockitic region[1] and both are characterised by the Eastern Ghats trend.[2] The remarkable similarity in their Alpha-Helium ages (1,350 M.Y.), though not dependable enough for dating the Eastern Ghats cycle precisely because of the loss of helium which may occur in ancient minerals.

is capable of suggesting that the iron ores of Ongole and Salem were deposited contemporaneously.

The similarity in the age-levels of Anakapalle (1,585 M.Y.) and Nellore pegmatites (1,625 ± 75 M.Y.) which are intrusive into khondalites and mica-schists respectively constitutes additional evidence in favour of the surmise[12] that the Nellore mica belt is a continuation of the khondalitic zone. The allanite-bearing pegmatites of Anakapalle and monazite-bearing pegmatites of Cuttack (which have yielded detrital monazite) are both intrusive into khondalites of Eastern Ghats and significantly enough, the apparent lead age of the former (1,585 M.Y.) is of the same order as the Pb_{207}/Pb_{206} age (1,570 ± 70 M.Y.) of the detrital monazite (207/206 age alone is dependable in the case of detrital radioactive minerals). Thus the radioactivity age data, besides indicating the continuation of the Eastern Ghats from parts of Orissa down to Nellore and beyond, also suggests that the pegmatitic display which marks the closing stages of the Eastern Ghats orogeny is contemporaneous in the various parts of Eastern Ghats.

The conclusions drawn on the age-levels of Archæan orogenic cycles on the basis of the radioactivity age data are fully supported by the structural evidence. Krishnan[2] suggests that (*i*) the Dharwarian trend is a continuation of that of Aravallis; (*ii*) the Eastern Ghats trend is younger than the Dharwarian as it is superposed on the latter; (*iii*) the Satpura trend is younger than that of Eastern Ghats as is evident from their interrelationships in Gangpur State.

A tentative chronological succession of Peninsular Archæans, based on the available radioactive and structural data, is given below. Besides ages based on mass analytical data, crude ages of Satpura (885 M.Y.)[4] and Dharwar (1,850 M.Y.)[13] cycles are also given to facilitate comparison with the crude age (*ca*) of Eastern Ghats cycle:

955 ± 40 M.Y. (Ca 885 M.Y.[4])
Satpura cycle.

Ca 1,625 ± 75 M.Y.
Eastern Ghats cycle.

2,300 ± 100 M.Y. (Ca 1,850 M.Y.[13]).
Dharwar cycle (= Aravalli cycle?).

The extent of time-lag between the three cycles indicates that the succession is incomplete.

The recent advances in the field of measurement of geologic time by radioactivity methods have greatly facilitated the bringing together of the two distinct, but nevertheless, mutually related approaches, *i.e.*, correlation of rock formations and dating of orogenic cycles, referred to at the outset. The K_{40}/A_{40}, K_{40}/Ca_{40} methods[14] of dating potassium-bearing rocks, lead method[15] for determining the ages of accessory zircons in the acid and intermediate rocks and Rb-Sr method[16] for dating accessory biotite in rocks have now made possible, the estimation of the ages of the rock formations directly, thus facilitating correlation in the sense of Fermor.[1] All these methods together with the modern Pb-210 method[17] can be used to date the pegmatitic minerals and from them the orogenic cycles, in the sense of Krishnan[2] and Holmes.[3,4] It is pointed out that the two sets of data are directly comparable as they have been arrived at by the application of similar methods. Work is in progress on these lines.

A detailed paper will be shortly published elsewhere.

The authors are grateful to Professor R. S. Krishnan and his associates for determining the Alpha-Helium ages of some of the samples sent by us, to Dr. D. N. Wadia for the specimens of allanite from Chota Nagpur and monazite from Mewar and to Mr. Ch. Leelanandam for his assistance in the analysis of radioactive minerals. The work has been sponsored by the Council of Scientific and Industrial Research.

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ACTIVE CARBON FROM SOUTH ARCOT LIGNITE

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BY virtue of its low ash content and the highly porous structure it develops on carbonisation, South Arcot Lignite provides an excellent raw material for the production of high quality active carbons.

An investigation of different methods of preparation of active carbon from lignite and a study of the adsorptive properties of the products obtained have been completed. Two main modes of activation are employed: (*a*) lignite was first carbonised into char which was subsequently activated by heating with different activating agents, and (*b*) the carbonisation and activation were conducted simultaneously in one step. In method (*a*), the char obtained by carbonising lignite at $600 \pm 10°$ C. was mixed with 40% zinc chloride solution in different ratios (1 : 1, 1 : 2, 1 : 3 and 1 : 4) or with 40% calcium chloride solution (in ratios 1 : 2, 1 : 5 and 1 : 6), the mixed masses heated at a constant temperature (500°, 650° or 800° C.) for 2½ hours, and the adsorptive properties of the products quantitatively determined by standard methods.[1] In method (*b*) dried lignite (−80 to +100 mesh) was mixed with different amounts of zinc chloride or calcium chloride solutions as above, and heated at a constant temperature in the range 500-800° C. for 2½ hours. Another activating agent used was phosphoric acid. The acid of sp. gr. 1·75 was mixed with lignite in various ratios, the carbonisation of the mass being done at 650° C. for 2 hours. Lignite char was also activated using steam as an activating agent at different constant temperatures in the range 500-800° C. and for different durations.

The adsorptive properties of the different types of active carbons obtained by the above processes were studied by determining the adsorption of iodine[2] (in KI solution), methylene blue, oxalic acid and malachite green in aqueous solutions, by shaking different quantities of active carbon with solutions of known strengths until equilibrium was established and estimating the amounts present in solution after adsorption. Titration methods were used for iodine and oxalic acid, and colorimetric estimation with a photo-electric colorimeter[4] was adopted for the two dyes.

RESULTS

1. The unactivated char itself was found to have good adsorptive properties, the extent of adsorption increasing with the temperature of carbonisation, reaching nearly a maximum at 650° C.[3] Carbonised at this temperature, 0·1 g. of the unactivated char adsorbed 5·1 mg. of iodine, 9·1 mg. of oxalic acid, 5·2 mg. of methylene blue and 6·8 mg. of malachite green. The percentage of loss on carbonisation was 64·5.

2. In steam activation the adsorptive power increases with the temperature of activation. Here also 650° C. may be taken as the optimum temperature, the loss of material becoming excessive at higher temperatures. There is a progressive improvement in the quality of the carbon on increasing the duration of heating. It will however be uneconomic to prolong the activation beyond 2½ or 3 hours in view of the higher loss incurred.

3. Table I illustrates the relative merits of the two modes of activation (*a*) and (*b*) described above. The results generally establish the superiority of method (*b*) for all activating agents except phosphoric acid for which method (*a*) gives a carbon of slightly better quality. Phosphoric acid yields the best carbon, and the products obtained with phosphoric acid and with zinc chloride are found to be superior to the trade carbons available in the market.[6] Variation of temperature in the range 500-800° C. has little effect on zinc chloride activation. For calcium chloride, however, 650° C. was found to be the best temperature. Also, the quality of the carbon was uninfluenced by the variation of the proportions of the activating agent within the range used.

TABLE I

Adsorption by 0·1 g. of carbon activated by zinc chloride, calcium chloride or phosphoric acid

Activating Agent	Method used	Temp. of activation ° C.	Weight in milligrams adsorbed			
			Iodine	Oxalic acid	Methylene blue	Malachite green
$ZnCl_2$..	*a*	650	34	7	4	4
$ZnCl_2$..	*b*	650	11	12	25	32
$CaCl_2$..	*a*	650	32	6	4	4
$CaCl_2$..	*b*	650	98	10	16	19
H_3PO_4 ..	*a*	650	150	14	54	60
H_3PO_4 ..	*b*	650	126	12	48	56
H_3PO_4 ..	*b*	800	110	12	45	54
Steam ..	*a*	650	90	12	15	18

4. While Table I gives the adsorption data for 0·1 g. of carbon only, similar data have been obtained for weights up to 0·5 g. and also for solutions of different concentrations. Plotting[1] log x/m against log c (x = weight of solute in g. adsorbed by m g. of carbon, and c = concentration of adsorbate at equilibrium), a straight line graph is obtained in accordance with Freundlich's isotherm, with a slight deviation at low concentrations.

5. The active carbons produced in this series of experiments were found suitable for decolorising solutions of molasses, palm-gur, and cane jaggery. 50 ml. of an 8% solution of molasses[5] in a buffer of pH = 6·5 was shaken with 0·5 g. of active carbon and the percentage decolorisation measured with a photo-electric colorimeter.[4] Similar experiments were conducted with palm-gur and cane-jaggery solutions taking 500 ml. of a 13% solution for each determination. Results are shown in Table II.

TABLE II

Type of activation	Percentage colour removed		
	Molasses (i)	Palm-gur (ii)	Cane jaggery (iii)
1 None-650° C. char	26	4	2
2 $CaCl_2$–(*b*)	71	15	9
3 Steam at 650° C.	73	22	15
4 $ZnCl_2$–(*b*)	90	27	20
5 H_3PO_4–(*a*)	95	35	25
6 H_3PO_4–(*b*)	92	33	23

†(i) 8% solution (50 ml.) 0·5 g. of carbon; (ii) 13% solution (500 ml.) 6 g. of carbon; (iii) 13% solution (500 ml.) 6 g. of carbon.

Complete decolorisation of palm-gur solution (150 g. in 400 ml.) could be effected by using 30 g. of H_3PO_4-activated char added in 6 batches of 5 g. each, the final product being a water-white syrup. For cane-jaggery solution of the same strength as above, a total of 40 g. of carbon in 8 lots was required. These figures compare very favourably with the weights of technical grades of carbon required for complete decolorisation of these products. The spent carbon could be revived to more than 50% of the original activity, by washing and re-heating at 650° C.

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CONTROL OF NEMATODES

IN an article featuring the soil pest complex in the March issue of the *Journal of Agricultural and Food Chemistry*, a new phosphorus compound is reported to be effective for the control of the soil pests known as nematodes.

The new compound is 0-2, 4-Dichlorophenyl 0, 0-Diethyl Phosphorothioate and is available as a 75% emulsifiable concentrate.

Chemical treatment for nematode control to date, has been limited to fumigating materials, all of which are highly phytotoxic. If properly applied, all plants in treated areas are killed and therefore application must be made before planting.

The new phosphorus chemical, which was developed by Virginia-Carolina Chemical Corporation is an insoluble liquid and is applied as an emulsion. It is not phytotoxic and has been successfully applied without damage to growing turf and ornamental plants. In extensive field tests on golf greens and turf during the past four years, excellent nematode control has been achieved with 125-200 lb. per acre of the 75% emulsion. No root damage was found at higher rates of application.

The new chemical was first synthesized by Doctors William P. Boyer and J. Roger Mangham in the Richmond, Virginia, research laboratories of Virginia-Carolina, while extending investigation into the field of phosphorus compounds originally developed by Dr. Gerhard Schrader of Leverkusen, Germany. Its effectiveness as a nemacide was discovered by Dr. J. R. Christie and V. G. Perry of the Bureau of Plant Industry, U.S. Department of Agriculture, under screening programmes for possible solutions to the nematode threat.

EXCHANGE OF BIOLOGICAL PUBLICATIONS WITH CHINA

THERE are 35 natural history societies co-operating closely with The Academia Sinica, which is the Central Scientific Organisation in China, and forming a combination with other scientific societies, known as the All-China Federation of Scientific Societies (headquarters at the Academia Sinica). These societies publish 42 journals concerned with the natural sciences of which 5 are issued at Federation level.

The *Acta Academia Sinica* is a journal of general science, containing many biological papers, mostly in English, French and Russian. The papers are translations of important contributions to specialised journals printed in Chinese. Thus, the intention of the *Acta Academia Sinica* is to provide "a window on the progress of Chinese science". There are besides specialised journals in Chinese, but the papers usually have long abstracts in English or French—sometimes in Russian. The principal journals in the natural sciences are: (1) *Acta Zoologica Sinica,* (2) *Acta Entomologica Sinica,* (3) *Acta Phytotaxonomica Sinica,* (4) *Acta Botanica Sinica,* (5) *Acta Geologica Sinica,* (6) *Acta Palæontologica Sinica,* and (7) *The Chinese Journal of Experimental Biology.* There is also the monographic *Palæontologica Sinica.*

The Academia Sinica publishes annual abstracts in Chinese of foreign biological papers and reprints for the purpose are welcomed. Moreover, it hopes in the near future to publish annual volumes of classified abstracts in the principal foreign languages of scientific papers printed in Chinese; and this prospect needs encouragement.

Exchanges are welcomed and all arrangements can be made through Dr. Tsao Jih-chang, Secretary-General, Academia Sinica, Peking, China. In making new exchanges the Academy is eager to acquire back-numbers as well, so that it can have full sets as far as possible. It would be grateful, too, for information on pre-1950 numbers of most scientific journals which are available for sale or exchange, as the periodicals in most Chinese libraries were seriously neglected between 1937 and 1949. Lists of standard books published during this period and offered for sale would be equally appreciated. Dr. Hsiang Ta, Chief Librarian, Peking University, Peking, appeals for similar information.

STEPS TOWARDS SYNTHESIS OF FOODSTUFF

A GROUP of plant physiologists at the University of California, headed by Professor Daniel L. Arnon, have announced the extraction of chloroplasts intact from the green plant cells, taking their chlorophyll with them, and their use for the production of sugar from water and carbon dioxide in laboratory vessels. It was a direct chemical synthesis without the aid of the green leaf or any living part of it. It was a duplication, without life, of what only life has hitherto been able to achieve.

Success came to the California research team after they had discovered the role played by adenosine triphosphate (ATP) in the process. ATP is a compound of phosphorus, present in every living cell, and has been known for a long time as essential to the cell's nutrition.

The present discovery has revealed that ATP and the vitamins such as riboflavin and ascorbic acid also play an essential role in plant life. The use of sunlight by plants involves four steps. First, the chlorophyll absorbs the light energy from sunshine. Second, the chloroplast uses that energy to decompose water into hydrogen and oxygen. Third, the active hydrogen is taken up by the ATP. Fourth, the ATP carries the hydrogen to the carbon dioxide and uses its energy to combine the hydrogen with the carbon dioxide. The result is the formation of a simple sugar and the liberation of oxygen.

This simple explanation of how plants achieve this process also reveals why phosphates are so necessary in plant fertilizers. Without phosphate the plant cannot make ATP and this cannot grow. Furthermore, it is now clear why green vegetables are necessary in human nutrition. For their own purposes they contain the ATP and the vitamins which the human body also needs for its growth and life.

Contrary to the common impression, plants are not efficient in the use of sunlight. Less than 1% of the sun's energy which falls on a field of grass, grain or vegetables is what is actually used in producing food. All the rest is absorbed by the soil, is used in evaporating water, or is dissipated as heat. But if a synthetic food factory could use as little as 2% of the available sunshine it would represent an enormous increase in the world's food production. This is a modest goal. Five per cent. efficiency is not too much to expect. Under the circumstances, Dr. Arnon's phrase "a new era of unlimited abundance" expresses a hope that is perhaps well justified.—UNESCO.

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HIGH ENERGY ELECTRON SCATTERING BY BERYLLIUM

THE nuclear scattering of 125 Mev electrons has been observed by Hofstadter, Fechter and McIntyre.[1] To correlate this experimental data, Schiff[2] has proposed the following one parameter functions to represent the nuclear charge density distribution:

$$\rho(r) = \rho_0 \exp(-r/a_1) \quad (1)$$

where $a_1 = 0{\cdot}74 \pm 0{\cdot}03$.

$$\rho(r) = \rho_0 [1+(r/a_2)] \exp(-r/a_2) \quad (2)$$

where $a_2 = 0{\cdot}55 \pm 0{\cdot}01$.

$$\rho(r) = \rho_0 a_3^4/[r^2+a_3^2]^2 \quad (3)$$

where $a_3 = 0{\cdot}91 \pm 0{\cdot}04$.

$$\rho(r) = \rho_0 \exp[-(r/a_4)^2] \quad (4)$$

where $a_4 = 1{\cdot}8 \pm 0{\cdot}1$.

Hofstadter *et al.*[1] have also proposed the following uniform charge contribution:

$$\left.\begin{aligned}\rho(r) &= \rho_0 \text{ for } r < R_0\\ \rho(r) &= 0 \text{ for } r > R_0\end{aligned}\right\} \quad (5)$$

where $R_0 = 2{\cdot}45$.

All the parameters given above are in units of 10^{-13} cm. Further, all the above models are equally consistent with the experimental data at 125 Mev.

Recently, McIntyre, Hahn and Hofstadter[3] have observed the nuclear scattering of 190 Mev electrons by beryllium. The relative values of the elastic differential scattering cross-sections have been measured at 60°, 70° and 90°. In the present investigation, we have used this data to discriminate between the above models by calculating the corresponding differential scattering cross-sections at the same angles for each model. Both experimental and the theoretical values have been normalised to unity at 60°. The values at other angles are given in the second and third columns of Table I.

TABLE I

Model number	Angles		Characteristic lengths	
	70°	90°	$\bar{R}_c$	$\bar{R}_s$
(1)	0·34	0·052	1·37	1·59
(2)	0·35	0·051	1·29	1·45
(3)	0·40	0·081	0·41	∞
(4)	0·32	0·037	1·23	1·29
(5)	0·33	0·035	1·18	1·18
Experimental	0·31	0·031	1·18[4]	1·20[5]

It is clear from the above comparison that only the Gaussian and the uniform density distributions can be regarded as reasonably valid. We have redetermined the optimum value for the parameter of the Gaussian function to correlate both the 125 Mev and 190 Mev data and obtained $a_4 = 1{\cdot}7$ and used this parameter in all further considerations.

The electrostatic energy for any charge distribution can be represented by a characteristic length $\bar{R}_c = R_c/A^{\frac{1}{3}}$ where R_c is the radius of a uniform distribution with the same electrostatic energy. The experimental observations on the X-rays from the μ-mesonic atoms essentialy measure the root mean square radius of the nuclear charge distribution. This introduces, for any charge distribution, another characteristic length $\bar{R}_s = R_s/A^{\frac{1}{3}}$ where R_s is the radius of a uniform charge distribution with the same root mean square radius. Using the above models, these characteristic lengths have been calculated which, along with the best experimental values are presented in the fourth and fifth columns of Table I. It is again clear from the above comparison that only the Gaussian and the uniform charge density distributions can be regarded as valid. This conclusion rectifies a previous incorrect rejection[6] of the Gaussian function where its parameter, appropriate for heavy elements, was used by oversight in calculating the electrostatic energy.

On the basis of the charge independence of nuclear forces Gombas[7] has shown that the proton and the neutron distributions do not significantly differ from each other. Thus the nucleonic density distribution may be taken to be the same as the charge density distribution. The experimental observations on the nuclear scattering of high energy nucleons do not support a uniform nuclear density distribution since different nuclear radii are required at different energies.[8] The nuclear reaction radius for protons turns out to be even larger.[9] It is hoped that all these discrepancies may be removed by adopting a non-uniform density distribution. Further, Yang[10] as well as Born and Yang[11] have shown that a reasonable correlation between the nuclear density distribution and the nuclear shell structure can be obtained by a Gaussian distribution and not by a uniform distribution. These considerations suggest that out of the suggested one-parameter family of models, the Gaussian charge density distribution is the most reasonable from the point of view of the available experimental data.

M. G. Science Inst., Navarangpura, Ahmedabad-9, October 8, 1954.

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K. M. GATHA.

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THE VISIBLE EMISSION SPECTRUM OF Br_2^+

THE emission band spectrum of bromine in the visible region as excited by a high power high frequency oscillator, is photographed on Fuess and three prism glass littrow instruments. Photographs of the spectra extending from λ 6500 to λ 4400 revealed an extensive series of about 300 bands degraded to the red as against about 80 bands in the region λ 6700 to λ 5000 known from the earlier work of Uchida and Ota.[1] These bands may be regarded as due to the ionised molecule Br_2^+ on the analogy of

TABLE I
Isotope effect

System I						System II					
$(Br^{79}\ Br^{81})^+$ v′	v″	$(Br^{79}\ Br^{79})^+$ cal.	obs.	$(Br^{81}\ Br^{81})^+$ cal.	obs.	$(Br^{79}\ Br^{81})^+$ v′	v″	$(Br^{79}\ Br^{79})^+$ cal.	obs.	$(Br^{81}\ Br^{81})^+$ cal.	obs.
15,	0	16·2	16	13·8	13	13,	0	13·0	13	11·3	11
16,	0	17·0	18	14·8	16	14,	0	14·0	13	12·2	11
18,	0	18·7	19	16·6	16	11,	1	8·2	8	7·1	9
19,	0	19·6	18	17·2	17	15,	1	12·4	12	10·8	12
17,	1	15·3	18	13·5	12	16,	1	13·4	12	11·7	12
18,	1	16·0	16	14·5	16	16,	2	10·9	11	9·5	11
21,	2	15·9	17	13·3	13	6,	6	9·7	13	8·4	11
21,	3	13·3	14	11·5	12	7,	8	13·3	13	11·7	13
0,	9	23·0	24	20·1	20	5,	9	17·9	17	15·5	17
6,	11	20·2	20	17·6	17	6,	10	19·1	21	16·8	14

similar bands attributed to Cl_2^+ by Elliot and Cameron.[2]

A preliminary vibrational analysis of these bands was made by Uchida and Ota on the basis of two systems. However, they admit that the v' and v'' numbering of the bands is arbitrary as the assignment of the bands is not supported by isotope effect.

In the present work the analyses of both the systems are considerably extended to include all the bands down to λ 4400. This has necessitated a renumbering of the bands and a re-determination of the vibrational constants. The new vibrational assignments of the bands are well supported by the bromine isotope effect which is well resolved for a large number of bands in both the systems. The agreement between the observed and calculated separations of the isotopic components is shown in Table I for some of the bands.

The following vibrational constants are obtained for the two systems.

	ω_e'	$x_e'\omega_e'$	ω_e''	$x_e''\omega_e''$	D_e'	D_e''	ν_e
System I	190·0	1·0	376·0	1·25	1·11	3·49	19290·0
System II	152·0	0·35	376·0	1·25	2·03	3·49	18782·0

The intensity distribution in both the systems is of the open Franck Condon parabola type which is normally to be expected for such divergent values of ω_e' and ω_e'' as above.

Full details of the analysis are being communicated to the *Indian Journal of Physics*.

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UNIT CELL AND SPACE GROUP OF TRI-PHENYL-METHANE

SOME differences were reported on the dimensions and the number of molecules in the unit cell of tri-phenyl-methane by the previous investigators.[1-3] A re-determination of the cell-dimensions and its space group was therefore undertaken.

Goniometric studies by Czapski two-circle theodolite goniometer shows that the crystal belongs to the orthorhombic hemimorphic hemihedral class $m\,m$ in accordance with the observations of Groth.[4]

Unit cell dimensions were measured by taking rotation photographs about the three axes. They were found to be $a = 14{\cdot}7$ Å; $b = 25{\cdot}6$ Å, $c = 7{\cdot}50$ Å. The axial ratios are: $a : b : c = 0{\cdot}567 : 1 : 0{\cdot}293$ which agree with goniometric ratios given by Groth[4] except that the c-axis is halved. The density of the crystal measured by flotation method was found to be 1·142 g./c.c. The number of molecules per unit cell comes out to be 8.

Oscillation photographs about the three crystallographic axes were taken and indexed by Bernal's[5] graphical method. Weissenberg photographs were taken and indexed by Wooster and Wooster[6] method.

From the indices of the reflecting planes, the following systematic absences are observed:

(1) Reflections (hkl) show no systematic absence; (2) Reflections (hol) are missing when $(h + l)$ is odd; (3) Reflections (okl) are missing when k is odd; (4) Reflections (ool) are missing when l is odd.

These characteristic extinctions correspond to the space-group C_{2v}^9—$Pbn2_1$. In this description, a and b are interchanged with respect to Space Group No. 33 of the International Tables.

The number of molecules per unit cell found experimentally is 8 whereas the number of molecules required by this space-group is 4. Cases of this type, though rare, are known.[8] Such results can only be explained on the assumption that the asymmetric units are polymers of molecules and not single molecules themselves. Thus it appears that the two molecules of tri-phenyl-methane polymerize in some way to form one asymmetric unit of the elementary unit cell as was first suggested by Mata Prasad.[3]

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December 1, 1954.

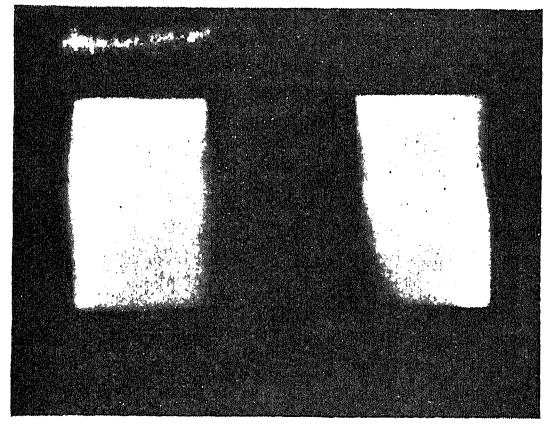
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EFFECT OF LEATHERS AND TANNAGES ON THE PHOTOGRAPHIC PLATE

As has already been reported by one of the authors,[1] substances like wood are endowed with the property of acting on a photographic plate even in the dark and imprinting on it an image. This phenomenon is known as the Russel Effect. A study of this phenomenon has now been undertaken in leathers of different tannages.

For the purpose of this experiment, cut portions from the butt of a heavy buffalo hide and a light cow hide were soaked, limed, unhaired and delimed according to the customary processes. The pelt so obtained was dehydrated in different changes of acetone and the perfectly white dehydrated pelt was kept as a stock sample. Cut portions of this dehydrated pelt were then tanned with different tanning materials: (1) 33% basic chrome sulphate, (2) 33% basic aluminium chloride, (3) 33% basic aluminium sulphate, (4) Wattle Tannin Extract, (5) 30% formaldehyde, (6) benzo-quinone, and (7) Divi-divi tanliquor.

The material was kept in contact with the tanliquors for a period of seven days with intermittent agitation. The tanned materials were washed free of the excess tanning material with distilled water and the materials dried. The tanned samples were then placed in contact with the photographic plates in total darkness and allowed to remain thereon for 48 hr. Details of the experiments have already been described in the previous notes quoted above. The plates used in the above experiment were Ilford Zenith Supersensitive Plates, having a speed of 700 H & D and a range of spectral sensitivity 2,300-5,200 Å. This plate has been found to be most suitable for all Russel Effect work. The plates were developed for 7 minutes at 75° F. using I-D-2 developer at tank strength.[2]



Thick Buffalo hide Light Cow hide
(Wattle-tanned)

An examination of the plates revealed that: (1) the dehydrated pelt which is a purely collagenous material does not give a picture; (2) the pelt treated with vegetable tanning materials like wattle, divi-divi, and benzo-quinone, gives very dense pictures; (3) the mineral tanning agents like aluminium, and chrome and also formaldehyde do not impart to the pelt the property of acting on a plate in the dark; (4) the thicker pelt from the buffalo, when tanned with vegetable tanning materials, gives a denser picture as compared to the thin material from the cow; (5) the action is exerted, as in the case of wood, through the pores of a filter-paper and through air. Even the fairly thick black paper used as wrappings for the photographic materials is unable to stop this action completely; (6) as in the case of wood, sunlight has the distinct effect of invigorating this phenomenon.

From the above observations, the following comments may be made:

(1) The protein as such does not have the property of giving a picture in the dark; but when impregnated with materials like vegetable tannin extracts or quinone which are readily oxidisable and reducible, it becomes photographically active. This is further confirmed by the fact that pelt tanned with other substances like basic chrome or aluminium salts does not show the effect; (2) with increase in thickness of the pelt, there is an increase in the density of the picture. This is probably due to the greater amount of oxidisable and reducible substances fixed with the thicker pelt as compared to the thinner one; (3) of the three easily oxidisable and reducible materials used for tanning—wattle, divi-divi, and quinone—quinone is found to be most active. This is shown by the denser pictures obtained with quinone compared to those of wattle and divi-divi tanned leathers; (4) as the action is exerted through air and pores of paper, the active substance or substances must be in the nature of a gas or vapour.

These studies show that any material that is readily oxidisable and reducible may have an action on the photographic plate even in the dark. It is probable that materials like rosin, tannin, etc., present in the wood, may be the root cause of the activity exhibited by wood samples. These studies, however, do not give any positive evidence that hydrogen peroxide is formed as a result of aerial oxidation and it is this that is responsible for the fogging of the photographic plate. Russel's peroxide theory,[3] therefore, still awaits confirmation by more conclusive experiments.

The photograph below is a positive print of the pictures obtained by a heavy buffalo hide and a light cow hide tanned with wattle tannin extract.

Further studies are in progress. Details will be published elsewhere.

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SPECTROPHOTOMETRIC STUDY OF FERRIC DIMETHYLGLYOXIME COMPLEX

It is well known that dimethylglyoxime forms complexes with various metallic ions.[1-4] The ferrous iron complex[5] with dimethylglyoxime gives in an ammoniacal solution a characteristic pink colour which is measured at maximum absorbancy. The presence of dimethylglyoxime prevents the precipitation of ferric salts as hydroxide even at high pH. This indicates the formation of a ferric complex, which is studied spectrophotometrically using a Beckman DU Spectrophotometer with a matched 1 cm. silica cell. Chemicals used in these experiments are E. Merck Guaranteed or B.D.H. Analar Reagents.

Dimethylglyoxime in alcohol shows a continuous absorption in the ultraviolet region [Fig. 1 (A)]. Ferric chloride in aqueous solu-

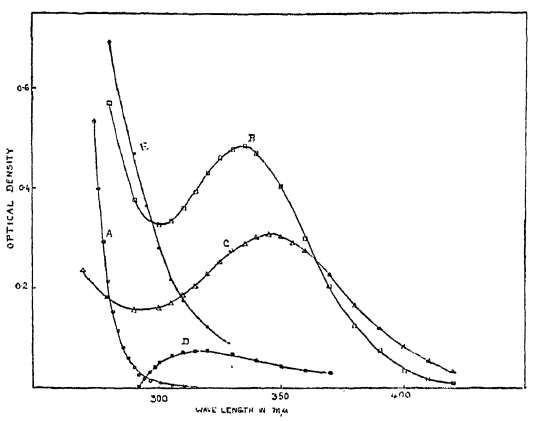


FIG. 1.

A—Dimethylglyoxime in alcohol 0·025% solution.
B—Ferric chloride in water 0·055 mg. of Fe_2O_3/ml.
C—Ferric chloride in alcohol 0·011 mg. of Fe_2O_3/ml.
D—Ferric chloride (0·0022 mg. of Fe_2O_3/ml.) and dimethylglyoxime (4·0 mg./ml.) in alcohol pH 10·4.
E—Ferrous dimethylglyoxime complex in ammonia C_{Fe} 0·0044 mg. Fe_2O_3/ml.

tion shows an absorption maximum at 335 mμ which shifts to 345 mμ on addition of alcohol [Fig. 1 (B, C)]. The colour of the alcoholic solution is deeper and the optical density greater than that of the aqueous solution. The absorption curves obtained with ferric chloride to which different amounts of dimethylglyoxime have been added are identical with the curve for alcoholic solution of ferric chloride.

However, an absorption maximum is obtained for the ferric dimethylglyoxime complex in

an ammoniacal medium. The absorption curve is measured with 1 ml. of ferric chloride solution (containing 0·055 mg. Fe_2O_3 per ml.), 10 ml. of 1% solution of dimethylglyoxime, 2 ml. of ammonium hydroxide (pH 11) and ethyl alcohol to make up the volume to 25 ml., and a maximum is obtained at 320 mμ [Fig. 1 (D)]. To confirm that this maximum is not due to the ferrous complex, the absorption curve for ferrous was also taken [Fig. 1 (E)]. It is clear that the maximum at 320 mμ is indicative of the formation of the ferric dimethylglyoxime complex. The necessity of addition of large excess of dimethylglyoxime in order to keep ferric salt in solution in ammoniacal medium is presumably due to the demands of the law of mass action. Without a sufficient excess of dimethylglyoxime the extent of complex formation would not be sufficient to prevent the precipitation of ferric hydroxide. The Beer's Law curve is shown in Fig. 2. The

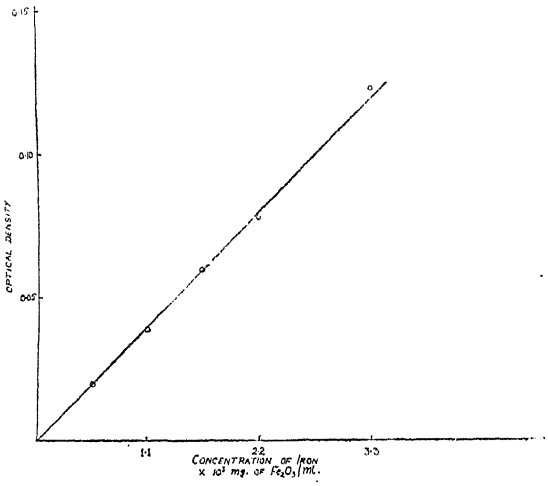


FIG. 2. X mg. of Fe^{+++} added to dimethylglyoxime (4·0 mg./ml.) in alcohol and pH adjusted to 10·4.

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DIAMAGNETIC SUSCEPTIBILITY OF THE TUNGSTATE ION

THE study of the diamagnetic susceptibility of some metallic tungstates and the tungstic acid was undertaken and from these results the susceptibility of the tungstate ion was calculated, as no work has been done so far in that direction. The substances studied were: tungstates of sodium, calcium, barium and lead and also tungstic acid.

Measurements of susceptibilities were made with a Curie balance. Water was used as the standard for comparison, its susceptibility at room temperature being taken to be $-\cdot72 \times 10^{-6}$. The containers were thin spherical bulbs blown from glass tubing having a low diamagnetic susceptibility. The retorsion method was employed, the specimen being brought to the identical position in presence of the magnetic field.

The susceptibilities of the metallic ions[1-3] used in calculating the susceptibility of the tungstate ion are given in Table I.

TABLE I

Ion	Na^+	Ca^{++}	Ba^{++}	Pb^{++}
$-\chi 10^6$	6·9	7·0	25·4	30·1

The results regarding the susceptibilities of the various tungstates investigated (mean of 5 determinations in each case) and the values of the susceptibility of the tungstate ion deduced therefrom are given in Table II. The mean

TABLE II

Substance	Mol. wt.	$-\chi \times 10^6$	$-\chi_M \times 10^6$	$-\chi \times 10^6$ of WO_4
$Na_2WO_4.2H_2O$	329·95	·203	66·9	27·2
$CaWO_4$	288·00	·126	36·4	29·4
$PbWO_4$	455·13	·133	60·6	30·5
$BaWO_4$	385·28	·142	54·8	29·4
H_2WO_4	249·94	·112	28·0	28·0

diamagnetic susceptibility of the tungstate ion is calculated from these to be 28·9. Weiss[4] pointed out the necessity of taking into account the ionic paramagnetic contribution of H as 1·00. If this is taken into account in the case of tungstic acid, the tungstate ionic susceptibility becomes 30·0. But in the present calcu-

lation, the ionic contribution of hydrogen, as is generally assumed, is taken to be zero.

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SELENIUM CONTENT OF 'KHESARI' (*LATHYRUS SATIVUS*) AND OTHER PULSES

LATHYRISM in man, in which spastic paralysis of the lower limbs is a marked feature, has been described in certain areas in India where *Lathyrus sativus*, which is often called 'Khesari' or 'Lang', is consumed over long periods. Rudra[1] has reported a high content of selenium (22·9 mgm.%) in 'Lang' as responsible for the neurotoxic effects. He has further suggested that selenium interferes in the utilization of sulphur and thus, with the metabolism of thiamine, biotin and methionine. 'Lang' is still raised as one of the main crops in some parts of Bombay State and its disposal has received considerable attention recently. In view of this, it was thought interesting to examine the varieties of locally available 'Lang', as also other commonly consumed pulses for their selenium content.

The selenium in the samples was estimated by the Davidson's wet combustion method.[2] The blue colour developed 2 hours after addition of 3% codeine sulphate solution, in an aliquot of the test acid digest was measured in the Unicam Photo-electric Colorimeter, using Filter No. 204. The values of selenium in test solutions were read from the standard curve, obtained by using different concentrations of selenium. Reliability of the method was checked by running few recovery tests by adding known amounts of selenium to the unknown sample. Selenium contents of the different samples analysed are given in the following table.

TABLE I

No.	Local name	Botanical name	Selenium mg./100 g.
1	'Lang', (big variety, with husk)	*Lathyrus sativus*	1·8
2	'Lang', (big variety, without husk)	do	1·0
3	'Lang', husk, (big variety)	do	1·4
4	'Lang', (small variety, with husk)	do	1·4
5	'Lang', (small variety, without husk)	do	1·5
6	'Lang', husk, (small variety)	do	1·6
7	'Lang dal'	do	1·5
8	'Chana' (Bengal gram)	*Cicer arietinum*	1·9
9	'Tur dal' (Pigeon pea)	*Cajanus indicus*	1·6
10	'Masoor', (Lentil)	*Lens esculenta*	1·5
11	'Moog', (Green gram)	*Phaseolus radiatus*	0·4*
12	'Watana', (Peas)	*Pisum sativum*	0·9*
13	'Kulid', (Horse gram)	*Dolichos biflorus*	*
14	'Milo'	*Sorghum vulgare*	1·9

* Green colour not characteristic of selenium

The results given above clearly indicate absence of any significant difference in the selenium content of 'Lang' and other commonly consumed pulses and a sample of imported 'milo'. Selenium was also estimated in 'Lang dal' and husk separately. The figures show that it is fairly equally distributed between the two on percentage basis. We are unable to confirm Rudra's[1] finding that the amount of selenium in 'Lang' is abnormally high (22·9 mg.%). This difference could conceivably be due to strain differences. However, the whole species of Lathyrus is believed to cause toxic effects. It is, therefore, suggested that the toxic substance responsible for the production of symptoms observed in Lathyrism may not be selenium. The recent isolation of a crystalline organic substance by McKay *et al.*[3] from *Lathyrus odoratus* (sweet pea) producing skeletal abnormalities as in Lathyrism, lends support to the probable presence of similar compound(s) in *Lathyrus sativus*.

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SEPTATE EPIDERMIS AND STOMATA IN THE TENDRIL OF *VITIS PALLIDA* W. & A.

ONE of us has already reported the occurrence of septate epidermal cells in the tendril of *Vitis repens*.[1] Figs. 1 and 2 show the septate epidermal cells in the terminal region of the tendril of *Vitis pallida*. A single epidermal cell is divided by anticlinal, periclinal or

oblique thin-walled septa. A similar condition is also observed in the middle curved region of the tendril.

The stomata are raised above the level of the epidermal surface. Each stoma consists of a pair of guard-cells, associated with a number of subsidiary cells (Fig. 3). Figs. 4-7 show some of the developmental stages. The guard-cells in surface view appear kidney-shaped with ledges of wall material on the upper and lower sides. The outer ledge has a layer of cuticle extending for a short distance into the stomatal aperture (Fig. 3). Both the ledges appear horn-like in cross-section. Occasionally there is a variation in the usual shape of the guard-cells (Fig. 8). The subsidiary cells, all round the guard-cells, are easily distinguishable in size, shape and form from those of the adjacent epidermis (Figs. 8 and 9). Some of them are parallel to the long axis of the pore and guard-cells (Figs. 7 and 9).

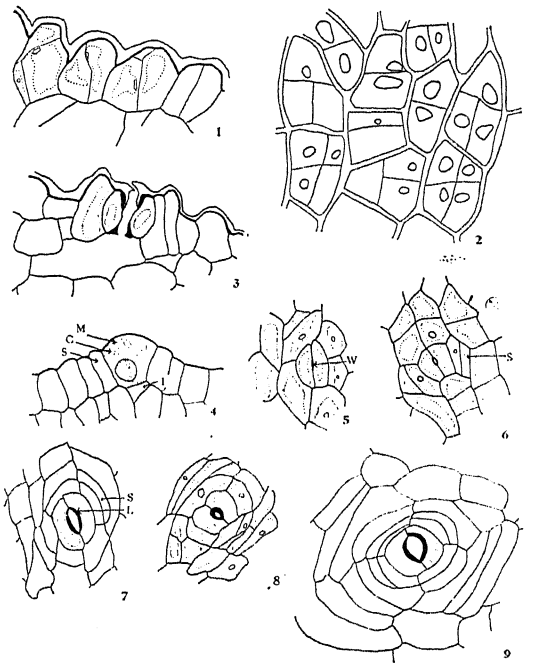


FIG. 1. Transection of the tendril showing septate epidermis, × 225.

FIG. 2. Surface view of septate epidermis, × 165.

FIG. 3. Transection of the tendril showing epidermis with stoma. Outer and inner ledges in solid black, ×375.

FIGS. 4 to 7. Developmental stages of a stoma in transection and surface views, × 225. M–mother cell; C–chloroplast; S–subsidiary cell; I–intercellular space; W–swollen intercellular substance; L–ledges.

FIG. 8. Stoma with guard-cells of unusual shape in surface view, × 225.

FIG. 9. Stoma of leaf in surface view; ledges in solid black; chloroplasts dotted, × 225.

According to Metcalfe and Chalk,[2] the stomata of the *Ampelidaceæ* (Vitaceæ) are ranunculaceous in the few species examined. In *Vitis pallida* they appear to be of the rubiaceous, paracytic type or C type of Metcalfe and Chalk.

We are grateful to Prof. P. Maheshwari for his interest in the work.

Dept. of Botany, M. S. University of Baroda and M. T. B. College, Surat, *July* 27, 1954.

A. R. CHAVAN.

J. J. SHAH.

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ANTIGENIC ANALYSIS OF PASTEURELLA

SCHUTZE[1,2] postulated the presence of two antigens in the plague bacillus, one contained in the 'envelope' and the other in the 'soma' of the bacillus. He showed that the envelope antigen was thermolabile and was responsible for the production of protective antibodies in animals. The somatic antigen was heat-stable and was found to have much in common with *P. pseudo-tuberculosis*. These results have been confirmed by Seal.[3]

Common antigens between *P. pestis* and *P. pseudo-tuberculosis* have been determined by previous workers using precipitin and agglutination techniques.[1-4] But these techniques suffer from the disadvantage that it is difficult to detect the presence of more than one common antigen. With the development of the gel diffusion technique by Oudin[5] the problem was studied afresh to determine the number of antigens present in the supernatant plague (strain 195/P), and pseudo-tuberculosis (PRI) vaccines. This technique was also used to find out the number of common antigens between *P. pestis* and *P. pseudo-tuberculosis* and other protective avirulent strains of *P. pestis* like TJS (Tjiwidej) and EV (Madagascar) and non-protective avirulent strains of *P. pestis*, like TRU and NC (a non-capsulated variant isolated by J. P. Menezes).

The vaccines from all these strains were prepared by the procedure adopted in Haffkine Institute for the routine production of plague vaccine described by Sokhey and Habbu.[6] The antisera were prepared by repeated subcutaneous and intravenous injections of the cultures killed with 0·07% formalin and preserved with 1·5 mg.% of phenyl mercuric nitrate.

The gel diffusion technique used in our laboratories is a slight modification of Bowen's[7]

procedure, and has been described by Kulkarni, Rao and Rao.[8] The results are summarised in Table I.

TABLE I

Results of Oudin's gel diffusion technique with different strains of Pasteurella

Antigen	Antiserum	Antigen-Antibody precipitin lines	
		intense	faint
195/P Vaccine	195/P	3	4
PRI Vaccine	PRI	2	4
PRI Vaccine	195/P	1	3
195/P Vaccine boiled for 1 hr.	195/P	1	1
195/P Vaccine boiled for 1 hr.	PRI	1	..
TRU Vaccine	195/P	3	4
TJS Vaccine	195/P	3	4
EV Vaccine	195/P	2	4
NC Vaccine	195/P	2	4

It is evident from Table I that *P. pestis* contains three soluble antigens in larger proportion and at least four in smaller amounts. Using Oudin's technique, Silverman *et al.*[9] obtained only three broad zones with the soluble fraction of *P. pestis*. It is also evident from Table I that *P. pestis* has one antigen in large proportion and at least three in lesser amounts in common with *P. pseudo-tuberculosis*. It is observed that the heat-stable antigen of *P. pestis* is the common antigen between *P. pestis* and *P. pseudo-tuberculosis*.

The electrophoretic analysis of the concentrated plague supernatant was also carried out in a Hilger electrophoresis apparatus at pH 8·6 in barbiturate buffer of 0·1 ionic strength. The ascending patterns were photographed from

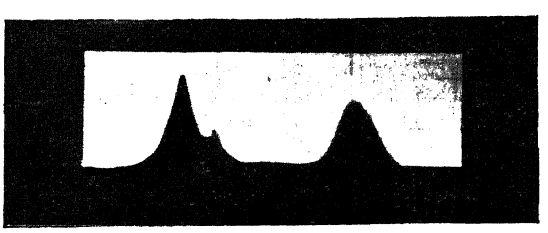


FIG. 1. Electrophoresis of Plague Supernate Time of exposure: 180 mts. Field Strength: 4·1 volts/cm.

time to time (Fig. 1). It is seen from Fig. 1, that there are three peaks indicating the presence of three components.

Attempts are in progress to isolate and purify the antigens of plague using Oudin's test[5] as a criterion of the purity of the fractions. The plague vaccine was fractionated with ammonium sulphate according to the procedure of Baker *et al.*[10] Each of the fractions contained 3-4 antigens. Seal[11] and Shrivastava[12] have used sodium sulphate for fractionation. In our further attempts to purify the protective antigens, we have obtained encouraging results by extracting the lyophilised antigens with solvents like ethylene glycol and diethylene glycol, and fractionating these extracts with acetone. The results of these experiments will be reported elsewhere.

The authors are grateful to Dr. P. M. Wagle and Dr. A. K. Hazra for their keen interest and for providing facilities.

Haffkine Inst., Bombay-12, *November* 16, 1954.

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EFFECT OF DDT, BHC AND PYRETHRUM ON STORED GRAIN

A SERIES of tests were conducted in the Entomological Division of the Institute during 1952-53 with 10 per cent. DDT, 0·5 per cent. γ-BHC and 0·2 per cent. Pyrethrin dusts with five different seeds, *viz.*, (1) Wheat Np 165, (2) Gram Np 58, (3) Barley Np 13, (4) Maize yellow 2, and (5) Rahar mixed. The concentrations were: 2 oz. per 125 lb. of grain for DDT, 2 and 4 oz. for 125 lb. of grain for BHC, and 2 oz. for 125 lb. of grain for pyrethrum. The treated grains were kept under normal conditions of storage, from harvest to sowing time.

Observations made so far show that regarding pest infestation and viability, wheat gives highly significant results with all the four treatments. Significant results have also been obtained in the case of gram as regards freedom from insect infestation, with BHC and pyrethrum treatments. In the remaining three grains,

viz., barley, maize and rahar, although the results do not give the same significant difference, either for viability or for infestation, the trend however, unmistakably shows that the treatments are satisfactory.

Indian Agric. Res. Inst., P. B. MOOKHERJEE.
New Delhi, *November* 14, 1954.

TRANSMISSION OF *TRYPANOSOMA EVANSI* STEEL, 1885 FROM MAMMALS TO FOWLS

GOEBEL[1] was the first to attempt a successful transmission of mammalian pathogenic trypanosomes into fowls directly from the hosts. Subsequently, Corson[2] and Hood[3] confirmed his findings. Their experiments however related to *T. brucei, T. rhodesiense* and *T. equiperdum* respectively. But no one seems to have attempted this type of transmission with *T. evansi* with success. The success achieved by the authors[4] in the transmission of *T. evansi* from chicks infected in the embryonic stage itself to other young chicks acted as an incentive to undertake this trial.

Sixteen chicks experimented upon were divided into two groups of which one received a heavier inoculum of the bovine strain of *T. evansi* maintained in a guinea-pig, while the other received a milder inoculum. Eighty per cent. of the first group revealed the flagellates by the fifth day with a tendency to increased intensity of the infection. A majority of these birds died in 2-3 days. The infection in the survivals persisted till the twenty-fifth day. Milder inoculum was noticed to delay the incubation period, the trypanosomes appearing on the tenth day only. Only 40% of this group were found infected and none of them died. Besides, the trypanosomes were not found to increase in number in contrast to the other group. Herein also the protozoa persisted till the twenty-fifth day.

Microscopical detection of the trypanosomes in the peripheral blood of the infected birds was an important finding, besides the successful direct transmission of *T. evansi*. Goebel, Corson and Hood could record their success only by biological tests. They could not see the flagellate in the peripheral blood under a microscope in any infected bird. Tenderie[5] too detected the infection in the fowl exposed to the bites of *Glossina palpalis* harbouring *T. brucei* by biological test only. Further, the death of the majority of the infected chicks within a few days, after revealing the organisms in blood is in sharp contrast to the observation made by us on the chicks infected during the embryonic stage. This is a pointer to a possible adaptability and lessening of virulence of *T. evansi* to avian species when the infection is given during the embryonic stage.

In conclusion, we wish to record three important observations made for the first time, *viz.*, (1) the possibility of successful direct transmission of *T. evansi* from mammals to fowls; (2) possibility of observing *T. evansi* under a microscope in the peripheral blood of such infected birds; and (3) possible adaptability and lowering of virulence of *T. evansi* to the avian host when cultivation is made during the embryonic stage of its development.

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UNUSUAL LOWERING OF SALINITY IN THE MADRAS COASTAL AREA AND ITS EFFECT ON THE PLANKTON

THE salinity of the Madras coastal waters is usually about 25 parts per thousand towards the end of October when the N.E. Monsoon sets in and increases to 33 in March and 35 in the summer months (Ramamurthy[1]). This year, however, the salinity fell to 19·45* on the 27th of October, from 34·24 in the beginning of the month. The sudden and considerable diminution of the salinity is unprecedented and so the features of the inshore plankton studied from 39 samples, collected from September 1 to November 15, are presented here.

As can be seen from the graph the drop in salinity from October 4th to 27th cannot be entirely related to the local rainfall on which depended the opening of the sand bars blocking the rivers Cooum and Adyar about the 20th of October. The salinity fell to about 22 before these local events took place. The dilution is therefore due to the currents from the northern part of

* Numbers relating to salinity are in parts per thousand.

the bay being conveyed to the south by the N.E. Monsoon winds (Sewell[2]). This is supported by the fact that on October 13 the surface water in the off-shore area had a salinity of 22·64 as in the inshore, but at a depth of 20 fathoms it was as high as 31·24, suggesting the southward flow of a large bulk of water of low salinity over the surface of water of higher salinity.

The volume of plankton increased considerably (see graph) about the third week of October when the salinity was approaching the minimum. This increase in volume was due to the diatom bloom induced by the rainfall rather than the lowering of salinity, for there was a similar flowering of diatoms in September when there were local rains and the salinity was 34.

ceras, Thallasiothrix, Bacteriastrum, Coscinodiscus, Rhizosolenia, Pleurosigma and *Biddulphia*. In October they were *Chaetoceras, Bacteriastrum, Rhizosolenia, Lauderia, Conscinodiscus, Hemidiscus, Thallasiothrix, Dityhum, Pleurosigma, Bacillaria* and *Skeletonema*. This lends support to Allen's[3] view that the diatoms can tolerate lower salinity conditions than those that are obtained normally. However, *Thallasiosira* sp., *Nitzschia closterium* and *Asterionella japonica* were absent in October presumably because they could not survive the fall in salinity.

The dinoflagellates also increased enormously during the October diatom peak. The species noted, in the order of abundance, were *Ceratium furca, C. massiliense, C. breve, C. tripos, C. fusus*, representing the genus *Ceratium* and

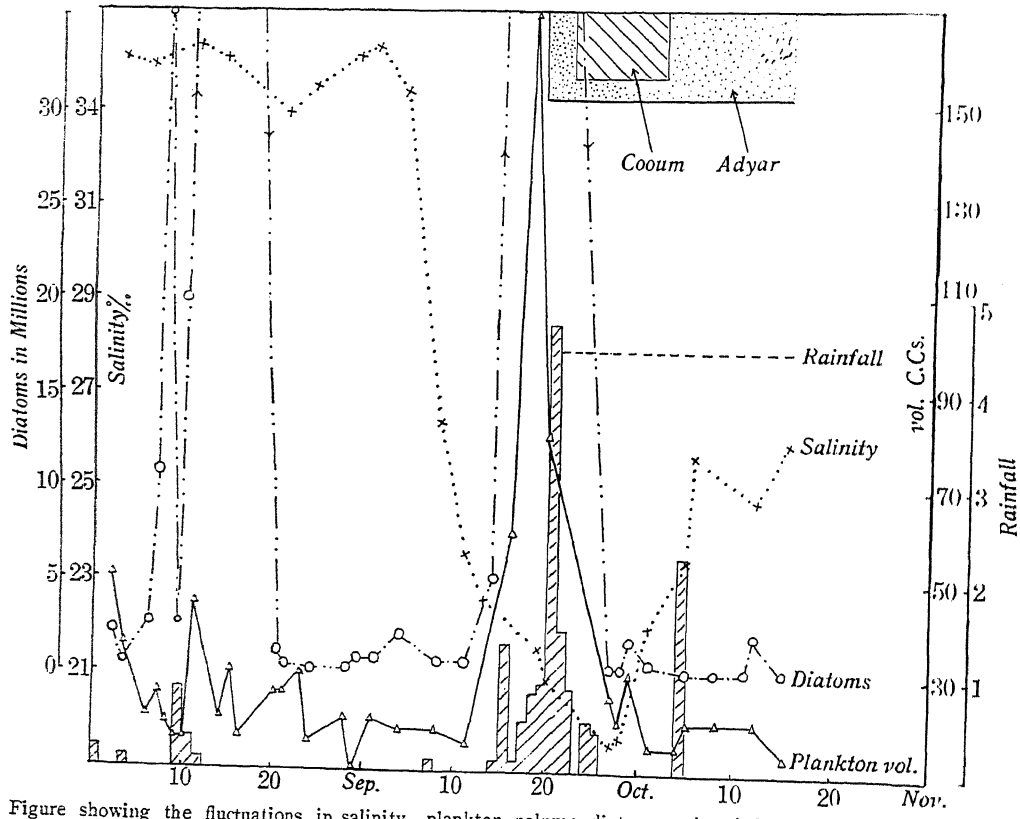


Figure showing the fluctuations in salinity, plankton volume, diatoms and rainfall. The periods during which the mouths of the two rivers Cooum and Adyar remained open are represented at the top.

Comparing the phytoplankton obtained in September when the salinity was 34 and in October when the salinity was 20, we do not find much difference in the composition of the population. In the order of their concentration the diatoms were in September as follows:— *Thallasiosira, Nitzschia, Asterionella, Chæto-*

P. depressum and *P. ovatum* representing the genus *Peridinium*. All the species appear to be euryhaline as they are recorded from high salinity waters normally.

Trichodesmium occurred in swarms when the salinity ranged from 20-25. From the records of Menon,[4] Menon[5] and Chacko[6] it appears that

Trichodesmium flourishes better in waters of low salinity.

Among the copepods *Acrocalanus longicornis, Paracalanus parvus, Oithona rigida, Corycæus* sp., *Eucalanus elongatus, E. crassus* and *Acartia erythræa* occurred in October in as large numbers as in September. However, *Euterpina acutifrons* appeared in smaller numbers in October and *Clytemnestra rostrata* almost disappeared during the period of low salinity.

Appendicularians represented by *Oikopleura* and *Frittilaria,* and the Hydromedusæ by *Obelia* sp. and *Liriope tetraphylla,* and Cladocerans by *Evadne tergestina* did not show any numerical depression in October.

Lucifer sp. which was common in September almost disappeared when the salinity fell in October. This is perhaps a stenohaline species.

Sagitta enflata, abundant in September, declined in October. But it was found that their decline coincided with the diatom increase. Since *S. enflata* once again appeared in fair numbers when the diatoms subsided it is possible that this arrow-worm avoids diatom patches and also does not tolerate as low a salinity as 20.

Siphonophores occurred irregularly till the end of October after which they appeared in good numbers. The occurrence of members (*Lensia subtiloides* and *Diphyes chamissonis*), of this predominantly oceanic group in large numbers on the 27th when the salinity was lowest is remarkable.

Larvæ of Polychætes, Gastropods, Lamellibranchs, Cirripedes, Copepods, Echinoids as well as young Pteropods (*Cresis acicula*) were as common in October as they were in September.

It can be concluded that a rapid lowering of salinity by 15 parts per thousand has not affected the composition of the inshore plankton to any marked extent. It is probable that the inshore surface forms are highly euryhaline.

Thanks are due to Professor C. P. Gnanamuthu, for guidance and encouragement.

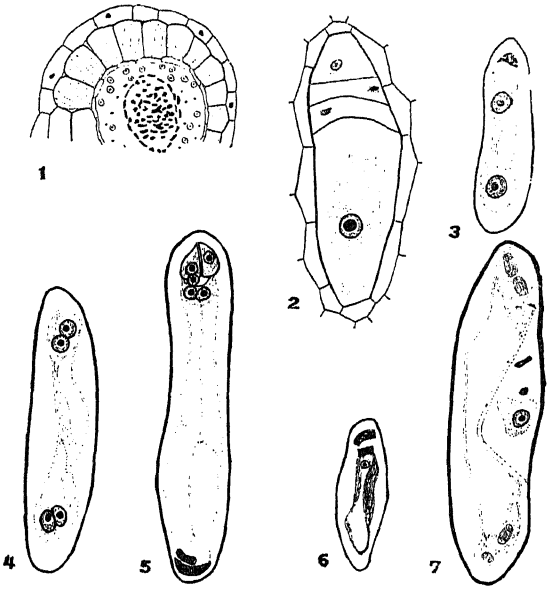
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FLORAL MORPHOLOGY OF *TERMINALIA BELERICA* ROXB.

Terminalia belerica belongs to the family Combretaceæ. The present note deals with microsporogenesis, megasporogenesis and development of megagametophyte in this species.

The wall of the anther consists of four or five layers of cells in addition to epidermis; the outermost of these forms a fibrous endothecium. The microspore mother cells undergo meiosis, and the resulting microspores usually show a tetrahedral, but occasionally an isobilateral arrangement. In some anthers degeneration of microspores has been observed (Fig. 1).



FIGS. 1–7

Fig. 1. Anther lobe showing the epidermis, fibrous endothecium and the degenerating microspores, × 70. Fig. 2. A linear tetrad, × 320. Fig. 3. Two-nucleate megagametophyte, × 160. Fig. 4. Four-nucleate megagametophyte, × 160. Fig. 5. Mature megagametophyte, × 160. Fig. 6. Degenerating megagametophyte, × 160. Fig. 7. Two megagametophytes in a single ovule, × 160.

The ovary is inferior, unilocular and usually contains two ovules which are bitegmic, crassinucellate and anatropous. Only one of the ovules develops into a seed; the rest degenerate and are crushed by the developing seed. The ovary is provided with unicellular hairs which are the modified epidermal cells.

There is a multicellular archesporium in the ovule, but usually only one archesporial cell develops further. Occasionally, two or more archesporial cells develop. Megasporogenesis proceeds normally and the arrangement of the megaspore tetrad is usually linear (Fig. 2).

The development of megagametophyte corresponds to Polygonum type. The antipodals degenerate early (Figs. 3, 4, 5). At certain stages of megagametophyte development, the nuclei of the gametophyte were found to disintegrate (Fig. 6). In a few cases two or more megagametophytes have been noticed in a single ovule (Fig. 7).

My sincere thanks are due to Prof. L. N. Rao for kind encouragement.

Dept. of Botany, M. NAGARAJ.
Central College, Bangalore,
December 10, 1954.

NEUROSECRETORY CELLS IN THE LARVAE OF GALL MIDGES

In Diptera the structure and functions of the cerebral neurosecretory cells are fairly well known. The excellent experimental investigations by Thomsen[1,2] and Possompes[3] have shown the significance of these cells in the physiology of the blowfly, *Calliphora erythrocephala*. But the neurosecretory cells of the larvæ of Diptera have not yet been extensively studied. Thomsen[4] has published the only important paper on the subject.

The gall midges (Cecidomyidæ-Itonididæ) form a remarkable group of Diptera showing a wide variety of physiological peculiarities including larval quiescence, diapause and delayed emergence of the adults. The latter is especially intriguing.[5] A lot of wheat-blossom-midge larvæ [*Sitodiplosis mosellana* (Gehin.)], collected in 1939, showed annual emergences, year after year, extending over a period of more than twelve years. Nayar[6] reported the occurrence of quiescence in the larvæ of *Schizomyia macarangœ* Nayar, which could be broken by contact of water. A similar condition has recently been observed in the larvæ of *Contarinia sorghicola* (Coq.) by Passlow.[7]

To understand the nature of the neurosecretory cells of the larvæ, the last instar stages were removed from the galls and the entire anterior half of the body or the central nervous systems dissected out, were fixed in Bouin's fluid, Allen's modification of the same or sodium chloride-formalin (10%) and sectioned at 5 or 7 μ. They were mostly stained in Gomori's chrome-hæmatoxylin-phloxin; some were stained rapidly in Groat's hæmatoxylin. *Lasioptera falcata* Felt., *Schizomyia macarangœ* Nayar and *Dasyneura brassicœ* (Winn.) were used for study. Live tissues were examined from the larvæ of *Lasioptera falcata* Felt. under the phase contrast microscope.

The brain shows the neurosecretory cells clustered together in the mid-region of the pars intercerebralis. These cells are large, and conspicuous, with prominent vesicular nuclei and rounded nucleoli. The crowding of these cells in the brain presents the appearance of a coalesced cluster. In simple staining with Groat's hæmatoxylin the cytoplasm appears blackish-blue; but in chrome-hæmatoxylin-phloxin it takes up phloxin also, and so looks bluish-red or red. The nucleoli are truly phloxinophil. Similar cells are seen scattered in the subœsophageal ganglion and as a cluster posteriorly in the ventral nerve cord.

The nervous system freshly dissected out in insect-Ringer and cleared from adjoining fat tissue, when examined under the microscope, shows tiny but conspicuous neurosecretory cells measuring from 6·15-10·1 μ and averaging about 8·58 μ in diameter. These cells are more than double the size of the other neurones in the brain. The cytoplasm shows under the phase contrast microscope, the secretory products composed of dark granules and vacuole-like bodies. The vacuoles vary in size and are of two distinct types; a set of small ones with black rims and clear interior—the spheroids—and a set of larger ones, transparent, with clear rims and tending to coalesce to form comparatively large droplets (Fig. 1). The latter shows granules within them. The picture resembles that given by Thomsen[4] in his Fig. 23 for *Tabanus* sp.

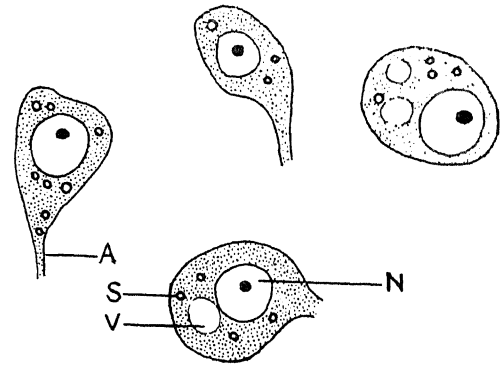


FIG. 1. Camera lucida drawing of four neurosecretory cells of the brain of the last instar larva of *Lasioptera falcata* Felt. seen under phase contrast microscope. The tiny granules in the cytoplasm are shown by stippling.

A: axon; N: nucleus with nucleolus; S: spheroid; V: vacuole.

The cells are well defined in the last instar larvæ. The histological changes in pupation and the histo-physiological nature of these in

diapausing larvæ and in their pupation are under investigation.

My thanks are due to Prof. Math. Thomsen and Dr. E. Thomsen for their hospitality and help during my stay in Copenhagen, where the work was started in August 1953, to Prof. K. Bhaskaran Nair, for facilities provided and to Miss B. M. Stokes, Rothamsted Experimental Station, England, for the larvæ of *Dasyneura brassicæ* (Winn.) used in this study.

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University College,
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ANATOMY AND MODE OF ACTION OF THE HEART OF *RANA TIGRINA* DAUD.

SHARMA[1] in describing the structure of the heart of *Rana tigrina,* noted that "The study is likely to throw light on an age-old controversy about the distribution and circulation of blood in the heart and *Truncus arteriosus*". Later, he summed up: "The 'classical hypothesis' and the 'complete mixture' theory do not hold good on the basis of the above anatomical facts and the conclusion drawn is, that the systemic and the carotid arches receive the same stream from the left auricle, and if at all, there is some mixture, it is small, and this is so, perhaps when the right stream is followed by the left, which takes a longer route through the central cavity".

A perusal of the literature discloses that as early as 1933, Vandervael[2] undertook an experimental study of the blood flow in the frog's heart. He made certain direct observations and proved the fallacy of the old theory with which Sharma currently appears to differ. Foxon and Walls[3] confirmed the observations of Vandervael and conducted further experiments by injecting X-ray opaque 'Thorotrast' and discovered that the head and lungs both showed the chemical and therefore, there was no selected flow to the head. Sharma's anatomical studies now disclose that the carotid and systemic share the blood from the left auricle.

Foxon[4] also described that considerable mixture took place at the base of the conus and that there was no difference of time in the entry of blood into the three arteries. Though commenting that his anatomical observations do not agree with the old theory, Sharma appears to take us back to the 'classical hypothesis' in noting that the admixture of blood is very little and that the entry of blood into the arches is not simultaneous.

It is hoped that his fuller paper will clear up most of these contradictions.

Dept. of Zoology, L. S. RAMASWAMI.
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METASTABLE FORMS OF CORDIERITE FROM FUSED ROCKS IN INDIAN COALFIELDS

IN a recent paper, Jagapathi Naidu[1] has described in detail the optical properties of cordierites found in vitrophyres and hornfelses associated with coal seams in the Raniganj and Jharia coalfields. Venkatesh[2] has also made an excellent study of the development and growth of cordierites occurring in the para-lavas of Bokaro Coalfield.

The present note is intended to place on record immediately the important results of researches on the polymorphism of cordierite carried out by Dr. A. Miyashiro of the Geological Institute of the Tokyo University. Miyashiro[3] has already described a mineral resembling cordierite occurring in volcanic rocks, under the name *Osumilite,* and indicated that cordierites from such environments described in the literature may prove to be *osumilite.* I give below an extract from a letter received by me from Dr. Miyashiro discussing the cordierite phases found by him in specimens of fused shale from Bokaro Coalfield, sent to him by the Director, Geological Survey of India:

"In my study there exist at least four closely related polymorphic forms having cordierite composition. Among them two metastable forms were found in synthetic products only. But I considered that they may occur in some pyrometamorphic or related rocks. I was expecting that probably some of the cordierite-like crystals described by Venkatesh[2] are actually one of those metastable forms. My

expectation was justified, as all the cordierite-like crystals in the specimens of fused Bokaro shales examined by me, were one of the metastable forms.

"The most decisive distinction between the metastable form and true cordierite, lies in the fact that the space lattice of the former is hexagonal while that of the latter is pseudohexagonal. Since single crystals are not available for goniometric measurement, this difference can be demonstrated only by high precision X-ray measurements.

"Optical properties are very deceptive. The metastable forms usually show anomalous biaxial character with 2V ranging from 0-80° (I confirmed it on the grains in the fused shale). The forms sometime show very complex twin-like optical structure between crossed nicols. However, the space group of the metastable form C 6/*mcc* is not compatible with twinning with twin plane corresponding to (110) and (130) as in the case of cordierite. I think that the twin-like optical structure is only an optical anomaly. As you know, lime garnet showing optical anomaly is usually divided into twin-like sectors and the form of the sectors is sometimes very complex. But this is only an optical phenomenon. X-ray measurements show that no twinning is present in the garnet. Similarly, twin-like sectors and consequent optical anomaly was proved in the case of milarite and xanthophyllite, so far as I am aware.

"Since the burning of Bokaro coal took place by natural causes the metastable form has become to fill all the conditions necessary for the strictest definition of a mineral. I am intending to call this new polymorph *Indialite* after India, for the natural occurrence is from India. This new metastable form is a very important compound in ceramic industry."

In an earlier communication Dr. Miyashiro had pointed out to me the presence of hexagonal and zoned crystals with variable 2V in the specimens of Bokaro para-lava examined by him (these may be seen in the plate and drawing accompanying Venkatesh's paper on the cordierites of para-lavas). Most of these supposed cordierite grains are, according to Miyashiro, uniaxial or biaxial, with small optic axial angles (less than 30°) and considered to be the alpha form.

According to Jagapathi Naidu, two types of cordierite are found in vitrophyres and hornfelses of the Laikdih seam at Ramnagar, Raniganj. One type is recorded to display pseudohexagonal boundaries in basal sections, with minute lamellæ parallel to these faces. These grains of cordierite are stated to be uniaxial or biaxial with small optic axial angles (below 20°). These properties are certainly different from those of normal cordierite, and these grains are presumably the metastable form *Indialite*. The second type is stated to have values of 2V ranging from 23-46°, which again is suggestive of it being one of the metastable polymorphs. The third type of cordierite described is from vitrophyres and hornfelses in the fifth seam at Jharia, and is also presumably a metastable phase though the values of 2V are higher (according to Miyashiro the values of 2V for the metastable forms range from 8-80°).

It appears to the writer that here in India, where we have occurrences of fused rocks resulting from natural burning of coal seams, *osumilite*, and the principal metastable phases of cordierite discovered by Miyashiro, will be encountered in them. Miyashiro's monograph on the polymorphism of cordierite is under publication elsewhere.* While recognising the value of the observational data presented by Venkatesh[2] and Naidu[1] in their papers, the aim of this note is to stress the importance of careful interpretation of data with the aid of X-ray studies and to focus attention on the excellent study of polymorphic transitions carried out by one of the foremost Japanese mineralogists.

My thanks are due to Dr. Miyashiro for furnishing me with his valuable data in advance of publication, and to Dr. M. S. Krishnan, Director, Geological Survey of India, for permission to present this note.

Geol. Survey of India, Madras-4, *January* 8, 1955. A. P. SUBRAMANIAM.

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* Since writing this note the paper of Miyashiro and Iiyama entitled "A Preliminary Note on a New Mineral, Indialite, Polymorphic with Cordierite" has appeared in *Proceedings of the Japan Academy*, 1954, **30** (8), 746–51.

CHROMATOGRAPHIC ANALYSIS OF SUGARS IN BANANA

THE identification of sugars in banana has interested several workers. The main sugar of ripe banana was reported by Mierau[1] to be a sucrose and this was supported by Geerlings.[2] The presence of sucrose and invert sugar was found by Yoshimura,[3] and the quantitative estimation of sucrose

glucose and fructose was carried out by Wehmer.[4] Widdowson and McCance[5] accounted the total reducing sugars of banana as the sum of glucose and fructose sugars and their observation supported the earlier work of Bailey[6] indicating the absence of maltose in the fruit. While analysing the ripe Gros Michel variety of banana, Poland and his co-workers[7] reported the presence of sucrose, glucose, fructose and small quantities of maltose. The purpose of the present communication is to report various sugars detected on paper chromatogram in the indigenous varieties of ripened and green bananas.

Fruit pulp of each variety of banana weighing 100 g. was macerated and two volumes of 80% alcohol added in each case for the extraction of sugars. The alcoholic slurry was strained through a cheese cloth and the extract centrifuged in each case. The clear extracts were made alcohol-free on a water-bath and made up to a known volume. The spots of the various extracts were made on a filter sheet and by the use of ascending paper chromatographic technique employing butanol-acetic acid-water (4 : 1 : 5) as developer and benzidine trichloracetic acid as spraying reagent, the location of various sugar spots was made. A guide strip was also run on the same chromatogram for the identification of sugar spots. The following different varieties of banana were investigated.

1. KADA BALE—*Musa balbisiana* Colla. Clone Kade bale.
2. CHANDRA BALE—*Musa sapientum* Linn. var. Chenkadali (Syn. Chandra bale).
3. CHANDRA BALE (red-coloured)—*Musa sapientum* Linn. var. Chenkadali (Syn. Chandra bale).
4. POOVAN—*Musa sapientum* Linn. var. Poovan.
5. PEYAN—*Musa sapientum* Linn. var. Peyan.
6. RASA BALE—*Musa sapientum* Linn. var. Rasthali.
7. PACHA BALE—*Musa cavendishii* Lamb. var. Pacha vazhai.
8. MADURANGA—*Musa sapientum* Linn. var. Monthan (Syn. Madhuranga bale).

An analysis of the chromatogram showed that all varieties of banana in ripened stages contain 7-8 different sugars of which 4 have been found to correspond to the positions of maltose, sucrose, glucose and fructose. Out of the remaining four spots, three of them have been located in the region lying above fructose and near about Rhamnosa. An unidentified spot below maltose has also been located.

While analysing the chromatogram for unripened fruit it was observed that sugars present were generally sucrose, glucose and fructose, but in some varieties (Kada bale and Maduranga) sucrose was found missing and in others (Chandra bale and Maduranga) fructose. Surprisingly glucose was the only sugar present in Maduranga variety. Since this is a vegetable variety which does not ripen in the normal course, it is assumd that the mechanism of starch conversion in the fruit might be different from that of the other varieties investigated. Further work is in progress to characterise the unidentified spots.

Authors thank Dr. V. Subrahmanyan for his keen interest in these investigations.

Central Food Tech. Res. Inst., B. S. LULLA.
Mysore, *October* 15, 1954. D. S. JOHAR.

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A NEW VARIETY OF SUGARCANE LEAF-HOPPER *PYRILLA PERPUSILLA NIGRIVENTRIS* VAR. NOV.

DURING the course of the study on the systematic position of the three Indian forms, *viz.*, (*i*) winter-spring-summer form; *Pyrilla perpusilla* (Walker); (*ii*) monsoon-autumn-form; *Pyrilla perpusilla* var. *aberrans* (Kirby); (*iii*) autumn-winter form; *Pyrilla perpusilla* var. *pusana* (Distant), Mukerji and Prasad[1,2] also found in winter, a few specimens which were comparatively dark-coloured and differing in appearance from the abovementioned forms. The last mentioned specimens were, however, more or less similar to the three known forms in their genital characters. Different combinations of this dark form with the other three were released for interbreeding experiments. The new mutant paired with the ordinary forms, but no progeny could be obtained. This indicates tentatively that this form is different from the rest and might have evolved as a mutant. The cross-breeding experiment, however, needs further repetition.

This variety can easily be identified by its general darker body colouration. It appears to all intents and purposes to be a new variety so far not described. The length of the male is 4·8 mm., with wing expansion of 17·5 mm. while the female is 8·2 mm. in length, the wing expansion being 19·0 mm. Since the ventrum of this new form is comparatively of a much darker tint than the others so far known, the name *Pyrilla perpusilla nigriventris* var. nov., is provisionally proposed for it.

Ind. Agric. Res. Inst., New Delhi, *April* 12, 1954.

S. MUKERJI.
V. G. PRASAD.

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TWO NEW XANTHOMONAS SPECIES ON LEGUMES

Two new bacterial diseases of leguminous plants, *viz., Butea frondosa* Konig. and *Tephrosia purpurea* Pers. were observed during the rainy season of 1953. This is the first record of the pathogens and each being highly specific to its own host has been allotted the status of *novum species.*

(1) *Xanthomonas buteæ* Bhatt and Patel sp. nov. incites leaf-spots on *Butea frondosa*, one of the most beautiful trees of the plains of India. In the early stage of the disease, the pathogen produces small water-soaked areas with a brown centre and pale yellow halo. Young leaves and injured tender stems are easily infected under high humidity and continuous rains so essential for the infection. With the progress of the disease, the spots increase in size to 0·8-1·2 mm., become round to angular and dark brown to jet black. The technical description of the pathogen is as follows:

Short rods, rarely in chains of two; 0·5 × 2·1 μ in size; single polar flagellum; gram negative; capsulated; agar colonies smooth, round, butyrous, raised and yellow; gelatin liquefied; starch strongly hydrolysed; casein digested; milk peptonised and litmus reduced; hydrogen sulphide and ammonia produced from peptone; acid without gas from arabinose, dextrose, lactose, sucrose and starch; no growth in salicin; no growth in synthetic nitrate and Czapeck's medium; nitrite and ammonia not produced from nitrate; optimum temperature for growth 27-30° C.; thermal death point about 51° C.; pathogenic to *Butea frondosa* only; found at Ambarnath (Kolaba), Bombay.

(2) *Xanthomonas tephrosiæ* Bhatt and Patel sp. nov. produces a few small, round, water-soaked leaf-spots measuring initially 0·5-0·7 mm. on *Tephrosia purpurea.* In the beginning, the spots are pale brown with small yellow halo around them which later increase in size to 1-2 mm. and become dark brown. The pathogen infects injured stem and rachis also. The technical description of the pathogen is as follows:

Short, single rods; 0·6 × 1·9 μ in size; single polar flagellum; gram negative; capsulated; agar colonies smooth, round, butyrous, raised and yellow; gelatin liquefied; starch hydrolysed; casein digested; milk peptonised and litmus reduced; hydrogen sulphide and ammonia produced from peptone; acid without gas from arabinose, dextrose, lactose, sucrose and starch; no growth in salicin; excellent growth in synthetic nitrate and Czapek's medium; nitrite and ammonia not produced from nitrate; optimum temperature for growth 27-30° C.; thermal death point about 51° C.; pathogenic to *Tephrosia purpurea* only; found at the Agricultural Farm, Poona.

Fuller details will be published elsewhere.

Plant Pathological Lab., Agricultural College, Poona, *October* 1, 1954.

V. V. BHATT.
M. K. PATEL.

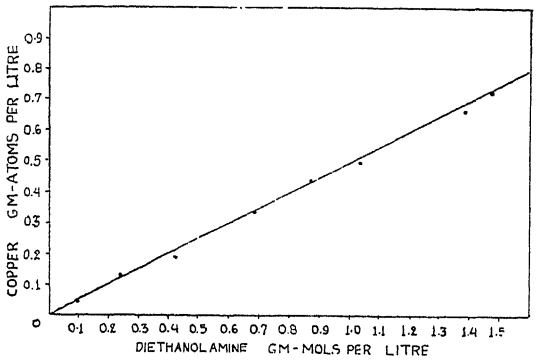
THE COMPLEX DIETHANOLAMINE COPPER HYDROXIDE

THE ability of copper to form complexes with organic amines is well known. In the case of ethanolamines, although the complex triethanolamine-copper has received considerable attention, experimental data for diethanolamine are comparatively lacking.

Hieber and Levy[1] isolated the compounds $CuCl_2.2(C_2H_4OH)_2NH$ and $CuBr_2.2(C_2H_4OH)_2NH$ by reacting the copper salts with the amine in absolute methanol. It would be, however, interesting to know if any other complexes are formed in aqueous solutions, particularly as Bolling and Hall[2] have recently proposed a 1 : 1 proportion in the case of triethanolamine-copper ion complex.

May and Baker's diethanolamine containing not less than 98% total bases as $(C_2H_4OH)_2NH$ was used. Solutions of different concentrations were prepared, shaken with excess of freshly precipitated copper hydroxide, made upto volume, centrifuged to remove suspended par-

ticles, and analysed for copper. This was done by adding successively solid $MgSO_4$, dilute H_2SO_4, ammonia, acetic acid, KI, and titrating against thiosulphate. Addition of $MgSO_4$ gave a better end point, probably due to the displacement of copper from the complex. A solution of the amine with known copper content was used as a check for this procedure.



The results show that the ratio of diethanolamine to copper hydroxide is 2 : 1 in the range studied. Any intermediate complexes with ratios 3 : 1 or more, if present, cannot be detected by this method, but a complex with 1 : 1 ratio is certainly not formed. Attempts to dissolve cotton in the diethanolamine-copper hydroxide solution were not successful.

The Ahmedabad Textile Industry's Res. Assn., Ahmedabad-9,
December 20, 1954.

A. G. CHITALE.
L. V. TOLANI.

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CHROMOSOME RACES IN *CHRYSOPOGON MONTANUS*

Chrysopogon montanus Trin. is a perennial grass distributed in India, Ceylon and Africa and it is used as a fodder crop. The somatic chromosome number of a strain of this species is reported by Darlington and Janaki Ammal[1] to be $2n = 20$.

Six distinct strains of this plant, two from Delhi (DLH-20, DLH-21) and one each from Lahore, Simla, Nagpur and U.S.A. (E.C. 5585), are maintained here (I.A.R.I.). A study of meiosis in these strains showed that one of these strains (DLH-21) was octoploid, *i.e.*, $n = 40$, while the other five strains had the gametic chromosome number $n = 10$ and thus those were diploids.

The octoploid strain is very easily ditinguished from the diploid strains since the former has deep green leaves, longer and more lax inflorescence and larger spikelets, florets and anthers. Fig. 1 represents a photograph showing the inflorescence of a diploid strain (DLH-20) and that of the octoploid strain (DLH-21).

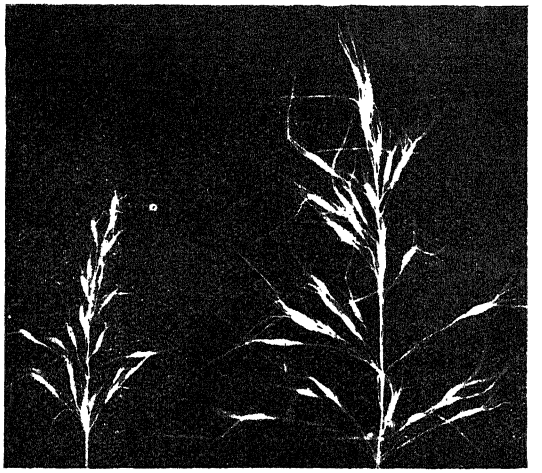


FIG. 1.

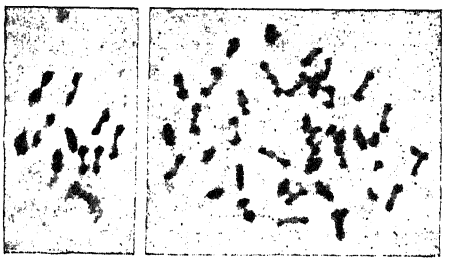


FIG. 2. FIG. 3.

FIGS. 1-3. *Chrysopogon montanus*

Fig. 1. Inflorescences of the diploid strain (left) and the octoploid strain (right) respectively.

Fig. 2. I metaphase plate of the diploid strain (DLH-20), Photomicrograph, × 800. Fig. 3. I metaphase plate of the octoploid strain (DLH-21), Photomicrograph, × 800.

Some of the salient features of meiosis, studied in two representative strains, are given below :

Diploid Strain (DLH-20).—At diakinesis and first metaphase 10 bivalents were noticed (Fig. 2). The mean chiasma frequency was 1·4 per bivalent (average of 50 plates each) at these two stages. As regards pollen fertility

97% of the pollen grains were stainable with aceto-carmine. The mean diameter of the pollen grains was $28{\cdot}4 \pm 0{\cdot}37\,\mu$.

Octoploid Strain (DLH-21).—At diakinesis and first metaphase a regular formation of 40 bivalents was observed (Fig. 3). The occasional precocious separation of 1-3 bivalents was noticed at I metaphase. The mean chiasma frequency was 1·5 per bivalent (average of 20 plates) at diakinesis and I metaphase. The slower movement of 4-8 chromosomes was observed at first anaphase, but in no case any lagging chromosome was seen in the cells studied at first telophase. As regards pollen fertility, 95·5% of the pollen grains were stainable with aceto-carmine. The mean diameter of the pollen grains was $46{\cdot}5 \pm 0{\cdot}7\,\mu$. The regular bivalent formation, absence of meiotic irregularities and high pollen fertility observed in the octoploid strain suggests that it is probably an allopolyploid.

Further studies in respect of chromosome morphology, seed fertility and crossability between the diploid and the octoploid strains are in progress.

The author's thanks are due to Drs. S. M. Sikka, A. B. Joshi and M. S. Swaminathan for kind help and suggestions during the present work.

Division of Botany, K. L. MEHRA.
I.A.R.I., New Delhi,
December 16, 1954.

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FEATURES OF HISTOLOGICAL INTEREST IN THE AIR-BLADDER AND PNEUMATIC DUCT IN *HILSA ILISHA* (HAM.)

RIDEWOOD[1] working on the air-bladder of British Clupeoid fishes, and Tracy[2] on American Clupeoid fishes concentrated their attention only on the ear-air-bladder connection and did not work out the histology of the air-bladder and pneumatic duct, which in case of *Hilsa ilisha* (Ham.) has revealed many features of considerable interest.



FIGS. 1 to 3.

As in other fishes, the wall of the air-bladder of this fish also consists of two layers: (1) tunica externa, and (2) tunica interna. The former is composed mainly of two layers, *i.e.*, a specialized external "narcreous layer" which is very thin, and an inner muscular layer (not elastic fibres), which forms the major part of tunica externa. Such a well-developed muscular layer has not been recorded so far in the air-bladder of any other fish. The tunica interna consists of a layer of conjunctiva tissue which is not very thick, its innermost layer having become columnar. Masses of blood capillaries are tightly packed together in the columnar cells and are covered by unmodified internal epithelium. I agree with Vincent and Barnes[3] in retaining the name "red-bodies" for such structures.

Another hitherto unreported feature is that the wall of the pneumatic duct consists of the same layers as that of the air-bladder with the only difference that the columnar layer is not so well developed, but the closely packed blood capillaries, and so-called "red-bodies" are completely absent. At several places the lumen of the pneumatic duct is divided into two, and this is brought about by the formation of two septa in the inner wall of the pneumatic duct which go on developing towards each other till they meet in the middle and fuse thus completely dividing the cavity of the pneumatic duct into two (Figs. 1-3).

In due course one of the chambers enlarges at the expense of the other which gradually diminishes in size and ultimately disappears and a single cavity is left again in the pneumatic duct. Such a thing occurs three or four times, depending on the length of the pneumatic duct of the fish between the alimentary canal and the air-bladder.

The work is being continued to determine the significance of such unique division of the pneumatic duct and a detailed report will be published elsewhere. It will be worthwhile to examine other British and American Clupeoid fishes to find out if such a division is present in those fishes because this division has also been observed in *Gadusia chapra* (Ham.), another member of the Clupeidæ.

Zoology Dept., P. N. SRIVASTAVA.
University of Allahabad,
September 16, 1954.

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PYROGALLOL AS AN INTERNAL INDICATOR IN FERROUS ION—DICHROMATE TITRATIONS

It has been found that pyrogallol, 1 : 2 : 3-$C_6H_3(OH)_3$, produces no colour with a pure ferrous salt, but a blue colour with a trace of ferric salt while a brownish red colour with a pure ferric salt. Moreover, under suitable conditions, pyrogallol when present in a solution containing ferrous ions is not oxidised by potassium dichromate solution until practically the whole of iron present is oxidised to ferric state and a trace of the oxidised product of pyrogallol imparts a red colouration to the solution. Based on these observations it was thought desirable to study the use of pyrogallol as in internal indicator in the estimation of iron by potassium dichromate.

The change was more easily perceptible if a few mls. of the titrated solution were viewed through a test-tube, 4" × ½", placed against a white tile, and it was sufficiently sharp to signify the end point. Each figure recorded in Table I is the average of duplicate determinations. The results obtained by using the proposed pyrogallol indicator are sufficiently accurate in comparison with those obtained by using previously known internal indicators.

Satisfactory results were also obtained by using hydrochloric acid in concentrations similar to those of sulphuric acid though the latter was preferable. Estimation of iron after reduction with stannous chloride and subsequent re-oxidation with dichromate was possible if this indicator was used. Ferrous gluconate could be successfully assayed by dichromate with this indicator. Stannic chloride and zinc sulphate or chloride did not interfere. The presence of orthophosphoric acid was essential. The use of pyrogallol, however, was inadmissible in presence of readily oxidisable organic matter or mercuric chloride and in residual or back titration methods.

TABLE I

Sample taken for each titration	No indicator		Diphenylamine Indicator		Diphenyl Benzidine Indicator		Pyrogallol indicator	
	0·1N $KMnO_4$	Ferrous Iron	0·1N $K_2Cr_2O_7$	Ferrous Iron	0·1N $K_2Cr_2O_7$	Ferrous Iron	0·1N $K_2Cr_2O_7$	Ferrous Iron
Strong Ferrous sulphate solution 5 c.c.	42·03 c.c.	234·5 mg.	41·62 c.c.	232·24 mg.	41·62 c.c.	232·24 mg.	41·67 c.c.	232·5 mg.
Weak Ferrous sulphate solution 10 c.c.	8·5 c.c.	49·47 mg.	8·9 c.c.	49·66 mg.	8·93 c.c.	49·84 mg.	8·87 c.c.	49·49 mg.
Reduced Ferric chloride solution 20 c.c.	5·84 c.c. Using Phosphoric acid and Manganous sulphate	32·59 mg.	5·76 c.c.	32·14 mg.			5·83 c.c.	32·53 mg.
Ferrous Gluconate 10 c.c. of 10% *w/v* aqueous solution	Ortho Phenanthroline Indicator 19·8 c.c. 0·1 N Ceric Sulphate → 109·98 mg. Ferrous Iron						20·0 c.c.	111·60 mg.

In a 250 ml. Erlenmeyer flask a mixture of 5 ml. orthophosphoric acid and 5 ml. sulphuric acid was taken with the solution to be titrated. To this 10 ml. of dilute sulphuric acid and 0·5 ml. of a 2% aqueous solution of pyrogallol were added. As the titration against decinormal dichromate proceeded no colour was developed until one-tenth of the total dichromate required was added (*i.e.*, until $Fe^{3+}/Fe^{2+} = 1/9$), after which a pale green colour was developed which gradually became very intense and finally at the end point the greenish tinge totally vanished and a pale brownish red tinge appeared. A drop of dichromate in excess intensified the brownish red colour.

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Pharmacy Training Centre,
Jalpaiguri (West Bengal),
September 28, 1954.

REVIEWS

Progress in Nuclear Physics, Vol. 3. Edited by O. R. Frisch. (Pergamon Press), 1953. Price 63 *sh.*

The present volume contains nine articles of which four deal with techniques of study such as the use of the diffusion cloud chamber, measurements with gas proportional counters, the properties of solid conduction counters, and the production of intense ion beams. The proportional counters used with a pulse analyser should prove very useful as a detector. While the resolution is inferior to that of crystal diffraction methods, the source strength required is much smaller. Solid conduction counters are only a curiosity at present and have been rarely applied, but the article in this volume may pave the way to improvements in their design and operation.

The article on Oriented Nuclear Systems deals with the production and detection of nuclei with oriented spins, a subject which is the meeting point of magnetism, spectroscopy and nuclear physics. Cerenkov radiations are discussed in their various aspects in an article of about 50 pages. These radiations are important not only because of their intrinsic interest but also by their application to the detection of cosmic ray particles in conjunction with photomultipliers. In his article on the annihilation of protons, Deutsch discusses in detail the positronium—a bound positron-electron system, analogous to the hydrogen atom. Even two modifications of this entity have been discovered *ortho-* and *para*-positroniums. There are two purely theoretical articles, one on stripping reactions and the other on the collision of deuterons with other particles.

Uniformly the articles are well written and are readily comprehensible to a non-specialist. The greatest value of this series of volumes is perhaps to such an interested reader who is not in a position to follow the recent advances from the original literature.

Physical Chemistry. By A. J. Rutgers. (Interscience Publishers), 1954. Pp. xix + 804. Price $ 8.50.

This volume is an addition to the several books of the same title now in use in different parts of the world and one that is bound to make its mark. Professor Debye remarks in his Foreword that this is a book that covers the subject completely giving the reader an impressive picture of the combination of the methods of thinking in physics and chemistry.

The volume under review is distinct in the choice of subject-matter, as well as in the manner of presentation. While the experimental background is kept in view, the treatment is essentially didactic. The extent of mathematical background that is expected of a student of the volume is such that an undergraduate in our universities may feel induced to look to some other book for his initiation. Every idea is developed fully, keeping an eye on the historical development. Wherever necessary, mathematical derivations are given in full and, once the ice is broken, the reader finds it smooth sailing. A mass of material is condensed and it is difficult to indicate any superfluous material.

The subject-matter is dealt in 35 chapters, with an additional chapter as an appendix on the physical chemistry of high polymers. The treatment, as well as the emphasis, is different from that of the usual text-books. The solid state, for instance, occupies over 6 chapters and one finds a fuller study of the symmetry properties of two- and three-dimensional structures than is usual in the common text-books of physical chemistry. Similarly, classical mechanics has a whole chapter. On the other hand, we find only the kinetic theory of osmotic pressure and not any of the other theories. While the modern theory of strong electrolytes receives a fair treatment, one looks in vain for solubility product and its analytical applications or of buffer action. Similarly in the treatment of reaction kinetics while both collision and transition state methods are considered, the reader is left to decide on the comparative merits of each approach and we find the most cursory reference to heterogeneous reactions. Diamagnetic susceptibility finds no place in the volume. The reviewer cannot help remarking on the uneven treatment of the different sections, some being quite modern, referring to recent work, while others are somewhat outmoded.

In spite of these defects the volume is well worth study and the reviewer strongly commends the book as one for reference by advanced students of physical chemistry in universities and colleges. The get-up and the

printing of the volume are up to the standard that one has come to associate with these publications.

S. V. A.

Survey of Literature on High Voltage Engineering and Allied Subjects, 1935-53, No. 1. (Memoirs of the Indian Institute of Science, Bangalore-3), (New Series). Editor-in-Chief: M. S. Thacker. 1954. Pp. 206. Price Rs. 6.

The literature references are selected first under the main subject, *viz.*, High Voltage Engineering. Allied fields such as theoretical electro-technique, fundamental theory, measuring units, electrostatics, dielectrics and such others have also been covered to make the survey useful to as many engineers and students as possible. The references under the headings and subheadings are arranged in chronological order of the publication. References under each year are arranged alphabetically authorwise. Besides the subject classification, the booklet contains an author index at the end. While the list of references cannot be considered exhaustive, there is no doubt that the present survey will be immensely useful to the young research worker in making himself acquainted with the standard and scope of literature published on special subjects.

Monomolecular Layers. (Symposium presented at the Philadelphia Meeting of the American Association for the Advancement of Science, 1951). Edited by Harry Sabotka, 1954. Pp. vii + 207. Price not given.

The volume under review consists of nine interesting articles covering a wide cross-section of recent progress in the chemistry of monomolecular layers, especially in the U.S.A. A paper on modern film techniques also describes equipment of ingenuity and sensitivity—an automatic dipping machine, a recording ellipsometer, recording film balance, etc. Articles exemplifying the application of monolayer techniques to the determination of molecular weights of proteins and mechanical properties of surface films on solutions of detergents are stimulating. With the help of the radioactive tracers the unforeseen adsorption of multiple amounts of gegenions on adsorption layers and the prodigious rate of horizontal diffusion along deposited monolayers seem to have been demonstrated. The papers dealing with radioactive tracer techniques contain valuable technical information on the application of this new tool to monolayer studies.

There is a chapter on the hydropholic monolayers and their adsorption from aqueous solution. The survey of the position on fluid-fluid outer faces studied by force-area measurements contains results of value and interest. The last two chapters describe a number of chemical reactions taking place in films and mixed films. Study of chemical reactions by surface potential measurements has elucidated the conditions which lead in several instances to a highly significant acceleration of rates in monolayers as compared to the same reactions in the bulk phase.

The volume, while supporting the importance of two-dimensional chemistry, brings out unambiguously the periphery at which physical and colloid chemistry, organic, bio- and analytical chemistry as well as chemical engineering and technology meet. The readers will find that the articles stimulate interest in a field of chemistry that has yet many unsolved riddles.

M. SANTHAPPA.

Journal of the Geological Society of Australia, Vol. I, 1953. Pp. 133.

This is the first volume of the *Journal of the Geological Society of Australia,* whose President is Prof. E. Sherbon Hills. This number consists of five articles on regional geology and tectonics. A. B. Edwards and G. Baker of the Commonwealth Scientific and Industrial Research Organization, Melbourne, have given an account of the scapolite-granulites of Cloncurry District, north-western Queensland, and the neighbouring copper mines. They compare the scapolitization to that of Kiruna District, Sweden. R. O. Brunnchweiler describes the outcrop areas of the Canning District and the Fitzroy Valley, and regards them as of Jurassic and Upper Triassic age, and not of Permian as formerly believed. He suggests that the Canning Desert area was an epicontinental shelf platform during the Mesozoic. E. Den Tex points out how the different structural components of the Kosciusko batholith may be identified and resolved in a semi-statistical manner in the Schmidt net. S. Warren Carey discusses the Rheid concept in tectonics, and examines the rheidity for various substances. He holds that the crust of the earth behaves as a solid for many tectonic processes, but that in the geosynclinal materials and orogenic zones, many fluid phenomena may occur. E. Sherbon Hills and D. E. Thomas discuss the preservation of grapolites in the Ordovician and Silurian rocks of Victoria, and hold the view that they have been

killed by fine suspended detritus in the upper parts of the turbidity currents.

The Journal has a high standard of research articles, and is worth subscribing for. Copies may be purchased of Dr. O. A. Jones, Department of Geology, University of Queensland, Brisbane.

P. R. J.

Harker's Petrology for Students, Eighth Edition. Revised by C. E. Tilley, S. R. Auckolds and M. Black. (Cambridge University Press), 1954. Pp. 283. Price 18 *sh.*

All Harker's books have been masterly presentations of the science of Petrology. His book on microscopic petrography has now run into the eighth edition, and is indicative of its great popularity and indispensability to students of Petrology. The eighth edition has even the greater distinction of having been revised by Prof. C. E. Tilley and others. The book is a fascinating and concise description of the several rock types under the microscope. Examples are taken from all over the world, and the book is thus rendered international. The revisers have added very useful references as footnotes, and students of research can go to these originals for detailed description.

In the chapter on acid plutonic rocks, no controversy is introduced on the latest theory of gravitization. The description of these rocks thus remain universal without being tied down to any theory of origin. Every student of Petrology should own a book of this kind, for it provides classical descriptions of rock types, such as one has to deal with either in going up for the Degree examination, or in conducting research.

P. R. J.

Technique of Organic Chemistry, Vol. VI. (*Micro and Semi-Micro Methods.*) Editor: A. Weissberger. By N. D. Cheronis. (Interscience Publishers, Inc., New York), 1954. Pp. 628. Price $ 12.00.

No organic laboratory can afford to be without this book, which is a most valuable addition to the literature of experimental organic chemistry, useful alike to students undergoing training in advanced organic chemistry and to research workers. Micro and semi-micro methods are of special interest for laboratories like those in our country which suffer from a chronic shortage of funds and for workers in the chemistry of plant products. The book gives a comprehensive review of available methods, but it is not a mere literature survey. For a given type of preparation or analysis, the methods are critically assessed, and recommended procedures are described with complete experimental details. The necessary apparatus is also described in detail with the aid of clearly drawn diagrams.

After a brief introduction explaining the applications and advantages of microtechniques, the book is divided into three parts dealing with general methods, preparations, and analytical procedures. Part I provides the background for applying micromethods to problems of preparation, identification, characterization and analysis in organic chemistry; it gives an account of micromethods of crystallization, distillation, sublimation, extraction, measurements of physical constants, and miscellaneous operations and tools. Micropreparations involving reduction, oxidation, halogenation and other unit processes of organic synthesis are described in Part II, which concludes with a chapter (by Dr. A. R. Ronzio) dealing with the special techniques and precautions used in microsyntheses with tracer elements. Microanalysis of elements, adequately covered in the books of Niederl, Pregl and others, has been rightly excluded from Part III, which discusses with a wealth of practical detail micromethods for characterization, functional group tests, and preparation of derivatives (for which the cumbrous new verb, derivatization, is used). The least satisfactory chapter is Chapter XVII in Part III, written in collaboration with Professor T. S. Ma and consisting largely of a tabular statement of the "present status of microprocedures for functional group analysis".

K. V.

Advances in Enzymology, Vol. 15. Edited by F. F. Nord. (Interscience Publishers, Inc.), 1954. Pp. x + 547. Price $ 11.00.

The latest volume in this series contains a useful collection of reviews on topics ranging from mechanism of enzyme action to the minutial of intermediate metabolism. The international flavour so characteristic of "Advances in Enzymology" is clearly discernible in the volume. Of the eleven contributions, four are from America, two from England, one from France, one from Japan, two from Australia and one from Germany.

In the first chapter Leach gives an account of the work done towards the elucidation of the "Micromechanism" of biocatalysis in oxidation-reduction reaction with particular emphasis on the use of enzyme models and on the prob-

lem of free radical formation. The author points out in his discussion that the kinetic approach to the problem will pave the way for a fuller understanding of mechanisms in the field. Wurmser has discussed the thermodynamics of immunological reactions. A brief summary of the various theories proposed to explain the action of hydrolytic enzymes is given by Lindley. In the critical and provocative article, the pitfalls in the kinetic approach employed in the study of enzyme action are taken cognizance of and the lacunæ in the various theories indicated.

Two chapters are devoted to a discussion of the recent advances in carbohydrate metabolism. While appreciating the importance of isotopic studies, the part played by inhibitors such as fluoride and iodoacetate in the elucidation of the glycolytic pathway and the analytical methods of the enzymologist in studying the separate reactions as a prelude to the investigation of the over-all mechanism of cellular metabolism. Racker sounds a note of warning against undue generalisation and advocates a pooling of information obtained by the use of different techniques before enunciating alternative pathways of carbohydrate metabolism. Stacey's article provides a concise and readable survey of recent work on the biosynthesis of polysaccharides which was greatly facilitated by employing chromatographic techniques and by the use of labelled sugar molecules.

The article of Ochoa on the "Enzymic Mechanisms in the Citric Acid Cycle" and another by Ratner on "Urea Synthesis and Metabolism of Arginine and Citrulline" are outstanding. These two contributions together present a rich harvest of results obtained by recent researches which followed the trail blazed by the pioneer biochemist, H. A. Krebs.

Singer and Kearney contribute a lucid and comprehensive review on pyridine nucleotide co-enzymes laying stress on their chemistry and scope of action. The discussion brings into sharp focus the diverse metabolic processes mediated by the pyridine nucleotide components of the cell. The enzymic reactions in which the role of pyridine nucleotide catalysis is proved beyond doubt, are summarised in a tabular form.

The thiaminases and the complex nature of the antithiamine factor in ferms has been discussed by Fujita with remarkable clarity.

Other contributions include "Rennin and the Clotting of Milk" by Berridge and "The Structure of Tobacco Mosaic Virus and Their Mutants" by Schramm in German. Although the style and scope of the various articles show great diversity, the reviewer was impressed by the stimulating tenor of most of the discussions. The Editor should be congratulated for the commendable discretion with which he has collected in one volume highly informative reviews on the manifold aspects of enzymology written by recognised authorities.

The book is free from glaring mistakes. However, the structural formula given to malic acid in page 300 is incorrect and this appears to have been overlooked.

K. V. Giri.

Recent Progress in Hormone Research, Vol. X. (*Proceedings of the Laurentian Hormone Conference.*) Edited by Gregory Pincus. (Academic Press, Inc.), 1954. Pp. 511. Illustrated. Price $9.80.

An account is given in the volume under review, of the proceedings of the Tenth Annual Meeting of the Laurentian Hormone Conference held at Ottawa in September 1953. As in previous volumes, the papers which were read at the Conference along with *verbatim* record of informal discussions have been printed in this volume.

There are six main sections: (*i*) nervous system: hormone interrelationships; (*ii*) thyroid hormone: physiology and biochemistry; (*iii*) comparative indocrinology; (*iv*) protein hormones; (*v*) the role of hormones in blood and blood-forming organs; and (*vi*) aspects of clinical indocrinology, with two or three research papers in every section. The scope and variety of papers are such that besides the endocrinologist, the pharmaceutical chemist, biochemist, clinician or the medical research worker will find in them matter of absorbing interest. Thus the salt alcohol extraction technique and crystallisation methods discussed in detail by Romans will be of value to the pharmaceutical chemist, while the discussion on the homogeneity of insulin along with the comments on the structure of insulin molecule will benefit the biochemist. The three papers in the section on nervous system: hormone interrelationships deal mainly with the relations which exist between adrenal cortex and various areas of the central nervous system. Porter, in one of the articles, clearly brings out the role of hypothalmus in the pituitary-adrenal co-ordination. The role of adrenal steroids on nerve function is similarly discussed at length by Hoagland.

Gross and Pitt-Rivers give in another section, a lucid account of their investigations on

triiodothyromin in relation to thyroid physiology. The fact that this newly-discovered compound is 5-10 times more active than thyroxine has led to considerable speculation in regard to its biogenesis and its role as the peripheral hormone of the thyroid gland. Their paper along with that of Lardy and Maley, in which the theory is proposed that thyroxine regulates metabolic rates by varying the efficiency with which cellular oxidations are coupled with phosphorylations, bring once again the investigations on thyroid gland to the forefront of hormone research.

Research work on endocrine mechanisms in insects has received a fresh impetus through the investigations of Bodenstein. The hormones secreted by specialised nerve cells are dealt with in great detail by Scharrer and Scharrer, while the relationships between thymus, œstrogens and lymphoid tumours have been studied by Kaplan and his colleagues. Gordon has presented evidence to show that endocrine glands participate in hemopoietic and blood-destroying processes. Zondek's paper on some problems relating to ovarian function, though strictly not a recent advance will, nevertheless, be of considerable interest to clinicians and research workers. The chemistry of corticotropins, their influence on electrolytic and fluid metabolism and also on stress states have been discussed at length and in the reviewer's opinion, will be of immense value to physicians and physiologists alike. The present publication is undoubtedly, a very valuable addition to the existing literature on recent progress in the field of endocrinology.

V. Srinivasan.
P. S. Sarma.

Chromatography. (*British Medical Bulletin*, Vol. 10, No. 3), 1954. Price Rs. 12-3-0. (Copies can be had from: Oxford University Press, Madras-2.)

Several publications on chromatography have appeared in recent years, but the one under review is of special interest to the medical profession. For, in addition to giving a general idea of the scope of chromatography, this Bulletin also shows how this recently developed technique can be of service to medicine either directly or indirectly. Starting with a general introduction by A. J. P. Martin, the veteran in this field, one finds that the general principles of chromatography are discussed by R. J. P. Williams. Then follow a number of articles on gas liquid chromatography, practical aspects of chromatography, chromatography of organic acids, peptides, inorganic elements, carbohydrates, phosphoric esters, porphyrins, nucleotides, thyroid hormones, antibiotics, vitamins, sterols and proteins, written by specialists in the respective fields. The concluding chapters are on the separation of amino acids and lower peptides by displacement chromatography by the use of ion exchange resins and on amino acid metabolism.

Commendable features in every chapter are the many instructive graphs tabulated data and up-to-date references to literature. Besides, the volume has some excellent photographs on the types of equipment used in chromatography and on the separation of amino acids from normal human plasma, sweat, urine, uribrospinal fluid and biological fluids obtained from certain definite types of clinical cases. In short, this special Bulletin is a mine of information on chromatography as applied to medicine, and should appeal particularly to those who are engaged in medical and biological research.

P. S. Sarma.

The Biochemistry of Semen. By T. Mann. (Methuen, London), 1954. Pp. xiv + 240. Price 16 *sh.*

Ever since artificial insemination has come to be accepted as a method of breeding in farm animals, the scientific study of semen properties has obviously become important. Within a short period, therefore, a considerable amount of research work on the histology of spermatozoa, physicochemical properties of semen, effect of extraneous factors on the viability of the spermatozoa, etc., have been carried out and a vast literature on the subject has grown up. Mann's monograph on "The Biochemistry of Semen", though it deals only with one aspect of seminology, is a step in the right direction and is very welcome.

The author is well known for his researches on the biochemistry of semen. His discovery of the presence of fructose as glycolysable sugar in seminal plasma and the evolution of "Fructolysis index" as a method of appraisal for sperm metabolism and activity stand out prominently as notable contributions to the study of semen.

The monograph is divided into 9 chapters. They serially deal with the two semen components, *viz.*, the spermatozoa and the seminal plasma; their physico-chemical properties; the influence of various extraneous factors, *viz.*, sperm inhibitors, spermicidal substances, short wave radiations, semen dilutors, deep freezing, etc., on sperm viability; the enzymes and proteins of semen plasma and spermatozoa respec-

tively; metabolic processes; and the effect of various chemical identities present in semen, *viz.*, lipids, fructose, citric acid, inositol and some of the nitrogenous bases, on the metabolism of the spermatozoa.

In Chapter II the author has, among other subjects, discussed briefly the methods of evaluating semen quality. It is felt, however, that if he had dealt with this subject in greater detail in a separate chapter (as he has done for fructolysis, citric acid, inositol), the monograph would have a wider usefulness not only among persons concerned with artificial insemination of domesticated animals, but also among those concerned with the clinical diagnosis of human infertility.

P. BHATTACHARYA.

The Structures and Reactions of the Aromatic Compounds. By G. M. Badger. (Cambridge University Press.) Pp. xii + 456. Price 63 *sh.*

The book provides an excellent correlation between the numerous facts and theories concerning the chemistry of aromatic compounds and as such, is a definite contribution to our understanding of aromaticity.

The chapters numbering eleven cover a wide range of aromatic chemistry and are written in a clear and logical manner. The first two chapters deal with the 'Benzene Problem' and its theoretical solution in terms of wave mechanics respectively. The treatment which is non-mathematical in nature will aid distinctly the chemist disinclined to mathematics to have a better understanding of π and σ bonds. The subsequent chapters present a number of critically selected reactions and properties of aromatic compounds, and discuss their theoretical explanation. Of necessity, some of the less important reactions have been left out of discussion which, however, is by no means superficial.

The book ought to provide stimulating and valuable reading to chemists wishing to keep in touch with the latest developments.

S. SWAMINATHAN.

Books Received

Glutathione (Proceedings of the Symposium held at Ridgefield, Connecticut, November 1953). (Academic Press), 1954. Pp. x + 341. Price $ 7.50.

Chapters in Physical Chemistry. By B. N. Phadke. (Dastane Brothers' Home Service, Poona-2), 1954. Pp. vii + 667. Price Rs. 14.

Chemical Pathways of Metabolism, Vol. I. Edited by D. M. Greenberg. (Academic Press), 1954. Pp. x + 460. Price $ 11.0.

The Theory of Cohesion. By M. A. Jaswon. (Pergoman Press, London), 1954. Pp. viii + 245. Price 37 *sh.* 6 *d.*

Some Beautiful Indian Climbers and Shrubs. By Borr and Raizada. (The Bombay Natural History Society, Bombay), 1954. Pp. viii + 286. Price Rs. 22.

The Production and Use of Power Alcohol in Asia and the Far East. (Report of a Seminar held at Lucknow), 1952. (Published by the Economic Commission for Asia and the Far East, United Nations, New York), 1954. Pp. 445. Price not given.

Introduction to Theoretical Organic Chemistry. By P. H. Hermans. Edited and revised by R. E. Reeves. (Elsevier Pub.), 1954. Pp. xii + 507. Price 38 *sh.* 6 *d.*

Introduction to Atomic and Nuclear Physics. Third Edition. By Henry Semat. (Chapman & Hall), 1954. Pp. xii + 561. Price 50 *sh.*

The Testing of High Speed Internal Combustion Engines. By Arthur W. Judge. (Chapman & Hall), 1955. Pp. xvi + 494. Price 75 *sh.*

Squaring the Circle and Other Monographs. By E. W. Hobson. (Chelsea Publishing Co.), 1953. Pp. 361. Price not given.

Irrigation and Hydraulic Design. By Serve Leliavsky. (Chapman & Hall), 1955. Pp. xii + 492. Price 126 *sh.*

The Lipids—Their Chemistry and Biochemistry, Vol. II. By Harry J. Deuel Jr. (Interscience Publishers, Inc.), 1955. Pp. xxvi + 919. Price $ 25.00.

PEACEFUL USES OF ATOMIC ENERGY

INVITATIONS to take part in the International Conference on the Peaceful Use of Atomic Energy which is to open at Geneva on August 8 have been issued to the 60 member States of the organization and to 25 non-member States who are connected with the specialized agencies. The Conference is expected to last 12 days. Dr. H. J. Bhabha (who was a member of the Advisory Committee) has been named as President of the Conference. Its Secretary-General will be Professor Walter Whitman, of the Massachussetts Institute of Technology.

SCIENCE NOTES AND NEWS

Male Gametophyte in Cultivated Jute

Shri R. M. Datta, Cytogenetics Department, Jute Agricultural Research Institute, Barrackpore, writes as follows: While studying the development of the male gametophyte in the two species of cultivated jute (*C. olitorius* Linn. and *C. capsularis* Linn.) for the last four seasons, the author came across only five pollen tubes in *C. olitorius* containing three sperms each, instead of the normal two.

Bonemeal and Hypophysectomized Male Toad

In continuation of a previous report in this Journal (*Current Science*, 1952, 21, 345), Mrs. K. Harris, Department of Biology, Madras Veterinary College, Madras, states that studies made with hypophysectomized male toad show that bone-meal extract can produce the emission of sperms even in the absence of the pituitary body.

International Congress of Neuropathology, 1955

The Second International Congress of Neuropathology will be held at the Royal College of Surgeons, Lincoln's Inn Fields, London, from 12th to 17th September 1955. Those desirous of attending the Congress and/or presenting papers are requested to communicate with Dr. V. R. Khanolkar, Director, Indian Cancer Research Centre, Chairman of the International Committee on Neuropathology for India, on the above address before 15th April 1955.

Symposium on the Chemistry of Pyrones

A symposium on "Recent Advances in the Chemsitry of Naturally Occurring Pyrones and Related Compounds" will be held in the Department of Chemistry, University College, Dublin, on July 12-14, 1955. The following have accepted invitations to participate: Dr. R. G. R. Bacon (Belfast); Professor W. Baker, F.R.S. (Bristol); Dr. E. C. Bate-Smith (Cambridge); Professor H. Erdtman (Stockholm); Professor K. Freudenberg (Heidelberg); Porfessor S. Hattori (Tokyo); Professor F. E. King, F.R.S. (Nottingham); Dr. W. D. Ollis (Bristol); Professor H. Schmid (Zürich); Professor T. R. Seshadri (Delhi); Dr. T. H. Simpson (Aberdeen); Professor K. Venkataraman (Bombay); Dr. W. B. Whalley (Liverpool); Dr. G. Woker (Berne).

Those wishing to attend this symposium are requested to communicate with Dr. Eva M. Philbin, Department of Chemistry, University College, Dublin. The registration fee is ten shillings. The programme will be sent to those registered.

Endeavour Prizes

The Imperial Chemical Industries (Publishers of the quarterly scientific review *Endeavour*) have offered the sum of 100 guineas to be awarded as prizes for essays submitted on a scientific subject. The competition is restricted to those whose twenty-fifth birthday falls on or after 1st June 1955. The subjects for the essays are as follows: The Earth's Magnetism, Man-Made Fibres, Climatic Changes, Scientific Aids to Food Supply, Respiration, New Metals for Engineers. The essays, which must be in English and typewritten, should not exceed 4,000 words in length, and only one entry is permitted from each competitor. Essays must be submitted without signature. The competitor's full name and address and date of birth should be disclosed in a sealed covering letter attached to the essay and addressed to: The Assistant Secretary, British Association for the Advancement of Science, Burlington House, Piccadilly, London, W.1, and must be received before June 1, 1955.

German Scholarships

The German Federal Government has offered Indian nationals four scholarships for post-graduate or doctorate studies in West German and West Berlin Universities for 12 months with effect from November 1, 1955.

The amount of scholarship is DM 250 (equivalent to about Rs. 280 p.m.) in addition to free studentship at the University. Travelling expenses from the German border to the University town and back will be paid. Candidates will be responsible for cost of passage from India to Germany and back. Candidates possessing First Class Master's Degree with good academic record, having command over the German language and below the age of 27 years on November 1, 1955, will be eligible.

Effects of Flying on Patients with Cardiovascular Disease

The enormous increase in air travel during recent years has, among other results, led to the necessity of considering its effects upon passengers suffering from organic disease. The physical standards insisted upon by Government services and by private air lines in the selection of pilots and air crews of all sorts are naturally very high. This attitude has perhaps led to the parallel conclusion that none but physically fit individuals can safely be subjected, as passengers, to the strains and stresses of this form of transport.

But according to the figures obtained from a recent survey carried out by Medical Committee of the International Air Transport Association from 13 different air lines, one cardiac death has occurred per 1,113,000 passengers carried, or per 800,000,000 passenger miles, on a five-year average.

Also examples from many different varieties of cases of organic heart disease would seem to show that flying is perfectly safe when the heart is well compensated, and that it is a reasonable risk in patients whose state of compensation is not perfect, provided that the journey is necessary, or provided it is of such personal importance to the patient that he is prepared to take what can accurately be described as a very moderate risk. Generalizations as to suitability or unsuitability for flying cannot be made. Every case must be considered on its merits. (*British Medical Journal*, 1955, Feb. 5, p. 311.)

Tracer Research Unit, NCL, Poona

The need for setting up a radioactive tracer laboratory at the N.C.L., Poona, was recognised early in 1953, and in October of that year, Dr. R. Scott Russell of Oxford University was invited to initiate the setting up of the laboratory. Dr. Scott Russell visited the laboratory again last December-January to advise on the tracer research programme and to check the safety precautions in regard to health hazards.

The tracer laboratory includes provision for installing a 100 mc. radium-beryllium neutron source. Due stress has been laid on health precautions. The laboratory is well equipped to undertake a wide range of radioactive assays and for autoradiographic work. So far, five shipments of radioactive isotopes have been obtained from the Atomic Energy Research Establishment in Harwell. Some ancillary components of the counting equipment have also been constructed in the laboratory.

Progress of Metallurgical Research

Circulars are being issued by the Metals Research Committee of the Board of Scientific and Industrial Research to all institutions and agencies conducting research in metallurgical field, with a view to gather information on the progress of the researches.

It is not the intention of the Committee to get detailed information of any research of a secret nature that is being pursued, particularly in the private sector. In order to protect the research workers' interest and to encourage fullest co-operation of all the national laboratories, universities, educational institutions and other bodies, information is requested on broad lines on the titles, aims, scope and progress of the work on hand or contemplated to be taken up in the near future.

Hg-Th Alloy for Low Temperature Thermometers

While mercury freezes at — 38° C., a mercury-thallium alloy with similar properties freezes at — 58° C. Used in thermometers this alloy presents various technical problems during manufacture but these have been overcome by H. J. Elliott, Ltd., U.K.. who now produce this type of instrument. As a result, temperatures between — 38° C. and — 58° C. can be measured without reliance on a spirit such as alcohol, pentane or toluene which, in a large bore, gives accuracy no more than to the nearest tenth of a degree centigrade. Thermometers using the mercury thallium alloy are therefore specially suitable for the same purposes as low temperature kinematic viscosity thermometers.

Advances in Cancer Research

Some of the major gains in cancer treatment and research made wholly or partly at the Memorial Centre for Cancer and Allied Diseases, New York, in recent years have been reviewed in their biennial report. These are: (*i*) for the first time sustained growth in massive quantities of human cancers in laboratory animals have been achieved. This enables researchers to work on a large scale hitherto impossible; (*ii*) over two decades, the cure rate for cancers of soft tissues of the type called "sarcomas" has risen from 6% to 39·5%; (*iii*) 6 mercaptopurine (synthesised by the Welcome Research Laboratories) has proved to be the most effective agent yet in restraining acute leukæmia; (*iv*) over the years, the number of patients with cancer of the stomach who can be treated surgically has risen from 10% to 75%; (*v*) surgical techniques have been

improved so that liver cancer can be treated by surgery on this vital organ; (*vi*) viruses have been adapted to destroy, rapidly and completely, human cancer cells of one type in the test-tube.

Ultrasonic Tanning

Australian scientists have demonstrated that calfskin pelts can be converted into leather by brief exposures to ultrasonic radiation while in the tanning bath. With vegetable tanning extracts the process is complete in from 1-3 hours. (Conventional tanning may take from 6-10 weeks.) With synthetic tanning liquors, results are even better. Chrome tannage with ultrasonic irradiation is more uniform but not much more rapid, probably because of the smallness of the colloidal particles.

This achievement, reported by R. L. Ernst and F. Gutmann, of the New South Wales University of Technology, is experimental and was carried out with a vibrating quartz crystal. Transducers and a continuous method of extracting heat generated in the process will be necessary before the economic importance of the discovery can be assessed.

Institution of Chemists (India) Associateship Examination, 1955

The Fifth Associateship Examination of the Institution of Chemists (India), will be held in November 1955. The last date for receiving applications from the intending candidates is 31st July 1955. The Examination in Group A (Analytical Chemistry) is divided into the following nine sections and the candidates will be examined in any two of them according to their choice, in addition to General Chemistry including Organic, Inorganic, Physical and Applied Analytical Chemistry—(1) Analysis of Minerals, Silicates, Ores and Alloys, (2) Analysis of Drugs and Pharmaceuticals, (3) Analysis of Foods, (4) Analysis of Water and Sewage, (5) Biochemical Analysis, (6) Analysis of Oils, Fats and Soaps, (7) Fuel and Gas Analysis, (8) Analysis of Soils and Fertilisers, and (9) Analysis connected with Forensic Chemistry.

Candidates registering their names as examinees *by the 30th April* 1955, will be entitled to avail of the Tutorial Classes.

Further enquiries may be made to the Honorary Secretaries, Institution of Chemists (India), Chemical Department, Medical College, Calcutta-12.

Indian Council of Ecological Research

With a view to promote and expand ecological studies on Indian vegetation, an Indian Council of Ecological Research has been recently set up with the following members:

Chairman: Shri C. R. Ranganathan, New Delhi; *Vice-Chairmen*: Shri K. L. Aggarwal, Dehra Dun; Fr. Santapau, Calcutta; *Members*: Dr. R. K. Saksena, Allahabad; Dr. S. L. Hora, Calcutta; Dr. J. K. Basu, New Delhi; Shri A. C. Joshi, Chandigarh; Dr. R. Misra, Saugor; Dr. L. A. Ramdas, Poona; Dr. S. P. Ray Choudhuri, New Delhi; Shri Salim Ali, Bombay; Dr. S. Sinha, Agra; Shri M. M. Srinivasan, Dehra Dun; Shri S. K. Seth, Naini Tal; Shri K. N. Kaul, Lucknow; *Secretary*: Dr. G. S. Puri, Dehra Dun.

The Council is expected to meet at the Forest Research Institute, Dehra Dun, sometime in 1955 to chalk out plans for the execution of ecological studies in relation to forestry, agriculture, desert control, soil conservation, flood control, etc. All interested in ecological research are requested to get into touch with the Secretary, Indian Council of Ecological Research, P.O. New Forest, Dehra Dun (U.P.), for further information regarding the co-ordinated programme of the Council.

Exchange of Medical Publications through WHO

Medical libraries throughout the world, which previously offered their surplus publications to other medical institutions for free distribution and exchange through UNESCO, will now offer them through the WHO Headquarters in Geneva. It will not itself collect and make shipments of such material, but will act as a central information service for medical libraries wishing to exchange and distribute material. All shipments of publications will be made directly from one medical library to another, after agreement has been reached on the exact items required and on the question of transport costs.

Award of Research Degree

The Gujerat University has awarded the Ph.D. Degree in Chemistry to Sri. C. C. Patel for his thesis entitled "Studies in Chalkones and Related Compounds", and to Sri. V. T. Oza for his thesis entitled "Some Reactions of Hyponitrites and Nitrites".

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SCIENCE AND MANKIND*

NUCLEAR physics, including particle physics, remains the principal frontier of advance in physics to-day. It presents a greater challenge to theoretical investigation than any other branch of science and within its field basically new concepts are needed to explain the phenomena observed. But nuclear physics is now the basic science of nuclear energy and of nuclear explosives. It receives greater support from all governments than any other branch of investigation in science. Motives less admirable than the pure search for knowledge of the structure of matter now ensure a continuing and growing interest in nuclear physics. The explosion of the first nuclear weapon did more than usher in a new era in warfare and in the provision of industrial power. It blew to pieces the world of pure research in which Rutherford had spent his life and in which he believed so passionately.

In a less spectacular manner, almost all branches of science are assuming increasing social importance. It seems that all knowledge is applied, sooner or later, both for the benefit of man and for his destruction in war. Mankind is faced with a choice: to use natural knowledge to solve the manifold problems of his continued existence with an increasing standard of living, or to use it to destroy men, the works of their hands, and, worse still, the products of their minds.

Science is the search for truth through natural knowledge. The danger is that in the face of the destruction which can be the fruit of that knowledge, men will turn away from the endeavour to understand nature and seek protection in enforced ignorance. World war with atomic, chemical and bacteriological weapons, waged as all-out conflict, could well provoke a revolt

* Abstract of Rutherford Lecture 1955, delivered by Professor M. L. Oliphant, at Madras, on 25th March 1955.

from science and a return to the primitive bliss of ignorance. Men of science could be wiped out as socially dangerous and the accumulated wisdom of three hundred years could be destroyed overnight.

It is uncomfortable to face up to these problems, perhaps the crucial problems of our time. The great American essayist, Emerson, has written :

> 'God offers to every mind its choice between truth and repose. Take which you please—you can never have both....He in whom the love of repose predominates.... gets rest, commodity and reputation ; but he shuts the door to truth. He in whom the love of truth predominates....will abstain from dogmatism....He submits to the inconveniences of suspense and of imperfect opinion, but he is a candidate for truth, as the other is not, and respects the highest law of his being.'

These words reflect the conflict in men's minds to-day. What matters most? The survival of mankind, with his precious heritage of culture and learning, or the victory in war of one ephemeral ideology over another, a hollow victory from which little of value can ever be salvaged ? In the name of a cold war men commit all the crimes of their adversaries. Is there any reason to believe that in a shooting war with nuclear and other weapons of mass destruction, men will preserve any moral scruples whatever ?

What is Science ?

The problems we face to-day have been created by technological applications of scientific knowledge. It is worthwhile, then, to examine the meaning of science and how it affects mankind.

Until about 300 years ago, the normal course of science was the patient observation of nature. Man in general remained a passive agent in the process. With few exceptions the results of such observations were not recorded, although they were incorporated into the lore of the countryside or became part of the traditional knowledge of the craftsmen. Because knowledge was confined almost exclusively to natural events observed by chance, attempts to weave from it any coherent natural philosophy produced intricate, rigid and generally completely erroneous conceptions. These false ideas so obsessed men that they deliberately distorted many elementary observations so that the results fitted into the philosophy popular at the time, or they avoided any conclusions not in accord with belief. For instance, from his very beginnings man must have had a very complete knowledge of the anatomy of animals and men. He dissected both for food or to embalm the dead. Yet it was less than 300 years ago that the English medical man, Harvey, showed that the blood circulated in the body as a result of the pumping action of the heart. Similarly, the Persians made surprizingly accurate observations of the apparent motions of the planets and stars, but were unable to produce other than mystical explanations because they lacked knowledge of mechanics.

The pursuit of knowledge changed its character and was accelerated through the adoption of the experimental method. As a result of this revolution, man became an active participant in the phenomena he observed. The revolution was not without bloodshed, for ancient beliefs had been woven into religion and social behaviour. Many of the revolutionaries paid with their lives for their love of truth. On the whole, mankind is logical and has an inherent respect for integrity, so that the enormous power of the experimental approach was soon recognised. Experiments were devised to test all hypothesis and any theory which did not accord with the results of experiment was discarded. The habits arose of free and open discussion of scientific problems and the results of scientific investigations were published. An ethic of science developed which made discussion and publication obligatory. Thus, as Sir Henry Dale has pointed out to me, Benjamin Franklin, who founded in Philadelphia a society for the discussion of the problems of his time, imposed upon its members an oath, part of which may be paraphrased as follows: "I swear diligently to seek the truth, and having found it, to impart it to others." Scientific knowledge was no longer guarded jealously and recorded in code or in Latin, but became the property of all.

One result of the development of the experimental approach, and of complete openness in science, was that many more men became interested. Science rapidly became a branch of learning with all the dignity and depth of the older disciplines but with far greater vitality. It flowed across national boundaries. There grew up, throughout the civilized world, a body of men devoted to science who, in this matter, were true internationals.

Basic and Applied Science

Scientific activity stretches over a whole spectrum of work, from basic science at one end to the applied sciences like engineering,

agriculture and medicine, at the other. There is no sharp division between basic and applied science but rather a gradual merging of one into the other. What is more, applied science is often able to provide tools and ideas for use in research in basic science. The real difference between the ends of this spectrum lies in the motives behind them. Knowledge of nature is sought in basic science which is an activity carried on for its own sake. Applied science, or technology, has an immediate end in view and an investigation is pursued or dropped according to the practical results and profit which can result. Basic and applied sciences are complementary activities and both are essential for increasing knowledge of nature and for the improvement of industry.

In general a considerable period elapses between the making of a fundamental discovery and its successful application for practical purposes. The technological problems associated with the industrial development of a discovery nearly always require more effort and expenditure for their solution than did the original basic research. Thus there are few basic problems remaining to be solved in that part of nuclear physics fundamental to atomic energy, but it will require a decade or two to find solutions to the many technological problems which stand between the fundamental principles and the commercially successful atomic power station.

Use and Misuse of Scientific Knowledge

Science and technology have wrought such a revolution in our way of life that through familiarity with changes we are often indifferent to the full implications of what is happening. For instance, there can be little doubt about the positive benefits which mankind has gained from the development of communications—travel by sea, land and air, printing and the press, the telegraph and telephone, the cinema, radio and television. When properly used, all these modes of communication aid commerce and technological advance, bring peoples of the world closer together, so promoting international understanding and goodwill, and, above all, enable men to share directly their cultural activities and ideas.

The application to medicine of the discoveries of biological science has practically eliminated the threat of death from infectious diseases; technological advances based upon researches in basic science have reduced hard labour and drudgery in almost every walk of life, from the home to the factory and the farm; the yields of produce from agriculture and animal husbandry have increased greatly, the quality has improved and land formerly unfit for farming has come into production; large-scale production methods have brought to the ordinary man much improved standards of housing and of comfort, beauty and entertainment; leisure has increased and education to the highest levels is open to all.

For all these things, which are part of present-day life, men and women who are not blase, disillusioned or soured will give thanks to science and technology. The processes of improvement of knowledge, and hence of its applications, will go on. Already we have before us the prospects of the complete conquest of disease in the very near future, of enormously increased agricultural production and of unlimited energy for all purposes from nuclear processes. Knowledge is available or is being sought which will bring these benefits to all men and help remove hunger, poverty, degradation and despair from the inhabitants of all parts of the world.

These same advances in knowledge, which set so fair a prospect before the eyes of men, bring with them also the possibility of destruction of man and of his civilization. Science, used for individual gain without thought for the consequences, can bring disaster. At the present time we face a crisis in the use of science which is of far greater immediate importance and which must be surmounted if our present civilization is to endure. This is the threat of war which has been for mankind a sort of undulant fever of increasing malevolence which now threatens his very existence. Man stands on the brink of a precipice of his own devising.

Before the advent of the atomic bomb the increasing mechanization of war had introduced new and inhuman characteristics into fighting. The development of "push-button" warfare, whereby a guided torpedo may be launched, a load of bombs dropped or a pilotless guided missile be sent on its deadly mission, had made of war an impersonal and immoral business. A warrior of the past experienced a peculiarly personal relationship with his adversary; skill, physical fitness and bravery were the hallmarks of the victor. What Professor Julius Stone calls the "dehumanizing" of warfare through mechanization has made these qualities of negligible importance. In a future war a girl, sitting at a telephone in a deep dug-out, may misinterpret a message over a bad line with the result that she launches a missile, which will

destroy a city and its million inhabitants. An electrical fault in a complex control network may release such a weapon by accident. Problems of navigation of a high-flying aircraft moving in bad weather to eliminate an industrial target of strategic importance, can lead to the destruction of a neutral city, its inhabitants and priceless treasures. The kind of mistake which occurred again and again in the last war can now have incalculable consequences and in the atmosphere of war is inevitable.

The banning of weapons of mass destruction offers no solution, for any nation facing defeat abandons all scruples and uses every weapon which could decimate the enemy. Excuses can always be found for the use of any diabolical weapon in retaliation. Both sides in the last war were fully armed with the banned weapons of gas and chemical warfare. The only reason that these were not used was that they were not good weapons: it paid to use aircraft to carry explosive and incendiary bombs rather than gas. Atomic weapons were used, and by us.

The wonderfully fruitful field of human endeavour, nuclear physics, which has led to such insight into the structure of matter and which for 50 years had been the preserve of the pure scientist, has assumed over-riding importance as the basis of both unlimited power for the future of man and unlimited powers of destruction of all that he holds dear. The nuclear scientist has come into the limelight in two guises, as the saviour of the Western world from Communist domination and at the same time as the inventor of the diabolic weapons which may destroy civilization.

It is an unfortunate fact that scientific advances yield guns as well as butter. Almost every discovery can be used for evil as well as for good. Even the medical sciences have produced the spectre of bacteriological warfare.

The Responsibilities of the Scientist

The part played by science and applied science in the modern community is so great that the control of activities in these fields can no longer be left to the scientist alone. This statement will sound like heresy to many men of science who believe sincerely in the established conception of complete freedom in the search for truth. In the realm of basic science investigations must continue in an atmosphere of complete freedom, for no one can know from one day to the next, where, how or when the next major discovery will be made, or in what direction the seekers for knowledge will turn tomorrow. Complete freedom does not imply freedom to injure other human beings, to commit acts of cruelty or to neglect the interests of others. The pursuit of knowledge must be governed by the ordinary rules of social conduct.

However, in the applied sciences—and we have seen how difficult it is to draw a line between basic and applied science—the social consequences of development are all important. Ruthless exploitation of men and of raw materials has followed many developments in applied science. Grave dangers can arise to life and to health through the adoption of new equipment or processes which have not been tested thoroughly or which produce unexpected side effects. The deliberate design and development of weapons of destruction is an activity unworthy of science, essential though it may be until a stable state of the world has been established. Activities in these fields must be subjected to social controls.

Technological development proceeds so rapidly that dangers and difficulties arise before external social controls can be established or made effective. Proper supervision can then come only from within the ranks of scientists and technologists. Men of science can no longer deny all responsibility for the uses which may be made of their discoveries or developments. The ethic of social responsibility must be made an integral part of the spirit of the search for knowledge and its applications. Such a feeling is growing rapidly, but it needs to be established on a stronger and more formal basis so that some restraints are imposed upon the ruthless, the cruel or the foolish scientist comparable with those exercised, in theory at least, in the practice of law and medicine.

Finally, it must be recognised that, except in his pursuit of knowledge, the man of science differs in no way from other reasonably intelligent men and women. He is as full of prejudices and failings. He is as much a creature of contradictions, for while he hates the misuse and misrepresentation of science and is irritated and alarmed by secrecy, he is in general passionately loyal. When his country is in danger he is as ready to sacrifice his work and many of his cherished ideals in order to defend her with his knowledge. He is often quite naive and sometimes irresponsible in matters of politics and business. He recognises the greatness and the integrity of men like Rutherford, but does not often reach those heights.

Nevertheless, the real man of science, the seeker after truth, is aware of the paucity of his real knowledge, but has an infinite faith in the ability of man to know and to understand. He experiences humility in the contemplation of the immensity of nature, but he is impressed deeply by the capacity of the human mind. He knows that he is part of nature, but feels that because man can comprehend it, even partially, he must be superior, in some subtle way, to this environment. For him nature has a beauty, a dignity and a reality which transcends even that sensed by the artist, for he apprehends not only with his senses, but with his mind. He knows that knowledge is never certain but that it grows with the efforts of men and so, ultimately, some men may find the truth.

COMBINED CHEMOTHERAPY IN TUBERCULOSIS

OF all the drugs recently found to be effective in the treatment of tuberculosis, isonicotinic acid hydrazide (isoniazid) stands in a class by itself. While not the "wonder drug" that some hoped it might prove to be, three years' experience has fully confirmed the original American reports that it has a remarkable effect *in vitro* and *in vivo* against the tubercle bacillus. It was therefore disappointing when early reports on isoniazid showed that both in the laboratory and in the treatment of patients (especially with pulmonary tuberculosis) tubercle bacilli developed resistance to the drug even more quickly than to streptomycin, and the indiscriminate use of isoniazid alone in the treatment of tuberculosis was generally condemned.

But recently many reports have shown that excellent results can be obtained by suitable combinations of isoniazid with P.A.S. or streptomycin. The latest report of the Medical Research Council, gives further information about the effectiveness of certain of these combinations. Four methods of treatment were compared in 588 patients. All received 200 mg. of isoniazid daily; 182 of them received in addition streptomycin, 1 g. daily (SH), 142 streptomycin 1 g. twice weekly (S2H), 159 P.A.S. 20 g. daily (20 PH), and 105 P.A.S. 10 g. daily (10 PH). Judging solely from the results at three months, streptomycin 1 g. daily *plus* isoniazid 200 mg. daily is not only the most effective of the four treatments, but also represents the most effective drug combination studied at any stage of the trial.

The best combination of these drugs remains uncertain. It is possible that changes in treatment may be more effective than any one combination. But the use of all three drugs together has the disadvantage that resistance might develop to all of them. In this connection two new drugs which show promise are terramycin (oxytetracycline) and pyrazinamide. Terramycin by itself has some activity against the tubercle bacillus, and it is interesting to note that G. B. Mackaness and N. Smith found that, like isoniazid, terramycin was effective in killing tubercle bacilli inside macrophages as well as in the test-tube.

More recently Sheila Stewart, F. W. A. Turnbull and J. W. Crofton have shown that terramycin in the lower doses has little to offer, even in conjunction with isoniazid, but that in a dose of 5 g. daily it does seem to delay the onset of isoniazid resistance. Resistance to terramycin was not observed in any of the groups. The authors themselves suggest that these results are not impressive, but that terramycin may have some place in combination with isoniazid when other drugs for any reason cannot be given.

Some recent American reports suggest that pyrazinamide is more promising. McDermott and his colleagues go so far as to say that pyrazinamide with isoniazid "provides probably the most effective therapy known". Pyrazinamide is a drug of considerable interest. Chemically it resembles nicotinamide, but has a pyrazine instead of a pyridine ring. Like nicotinamide, it is not very active in the test-tube against tubercle bacilli except in special conditions, but showed promise in experimental animals. When first used in man it was found to be too toxic for prolonged administration in effective dosage, but if the recent American reports are confirmed, its combination with isoniazid is an important step forward. (*British Medical Journal*, 1955, p. 465.)

ULTRASONIC VELOCITY AND ABSORPTION MEASUREMENTS IN POLYMER SOLUTIONS

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ULTRASONIC velocity in solutions of *monomers* (vinyl acetate, methyl methacrylate and styrene) in benzene shows a linear variation with concentration in the range of concentrations studied (0-10% by volume), while the absorption decreases rapidly from that of pure benzene as more of the monomer is dissolved but in a normal and steady manner. On the other hand, solutions of *fractionated polymers* in benzene show the peculiar and hitherto undiscovered phenomenon of rapid fluctuations both in velocity and absorption from the values appropriate to pure benzene, as the concentration is varied. This new result first obtained by us in the case of polyvinyl acetate was later found to exist in the cases of polymethyl methacrylate and polystyrene also.

The variation of velocity and (α/f^2) where α is the absorption coefficient, with concentration is plotted for one fractionated polyvinyl acetate sample in Fig. 1. The 'wobbling' of

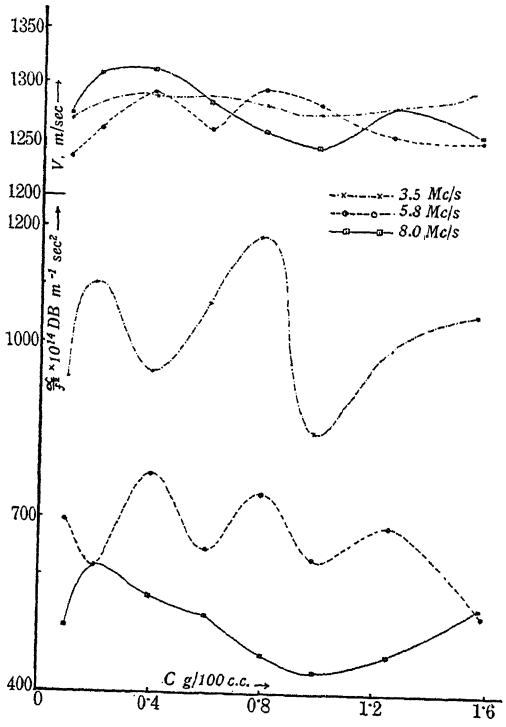


FIG. 1

these factors with concentration is most striking and appears to result from the presence of a number of relaxation frequencies characteristic of the polymer molecule.

Fig. 2 shows the plot of $\alpha\lambda$ (absorption per wavelength) against the frequency, for one

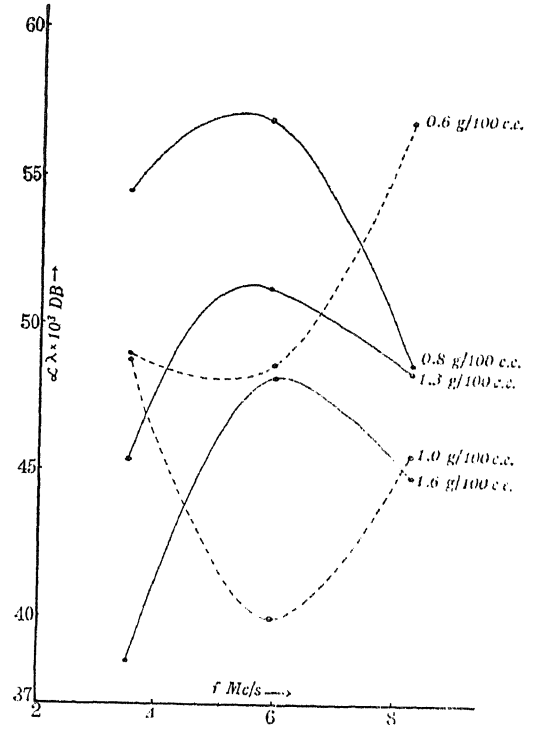


FIG. 2

fraction of polyvinyl acetate as an illustration. Each curve in the graph represents the values for a particular concentration of the solution mentioned alongside the curve. In the range of frequencies studied, there is a frequency at which the maximum for $\alpha\lambda$ is occurring for some concentrations of the solution, while for some others a minimum absorption is observed. The frequency showing the maximum absorption is not the same for all concentrations and is found to vary in an irregular fashion. Fig. 3 shows the variation of velocity with frequency and as in Fig. 2 each curve represents a particular concentration. This graph shows that the velocity is not constant with frequency and also that its variation is erratic. The above results observed in the case of all the different polymer fractions, indicate the presence of

multiple relaxation frequencies. The minima observed for some concentrations in Fig. 2 can only be explained as due to the presence of at least two relaxation frequencies situated very close to each other and on either side of the minimum.

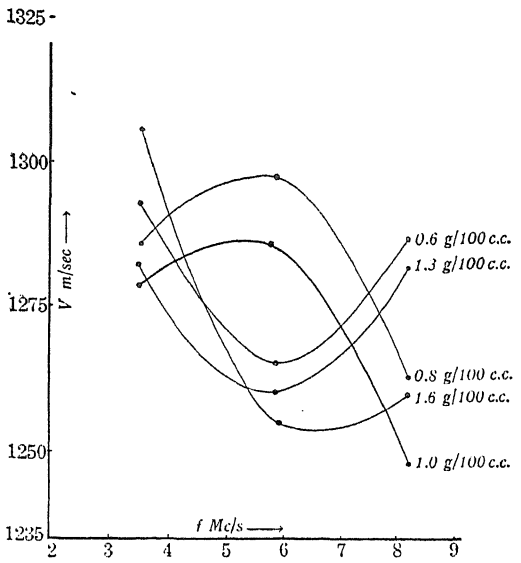


FIG. 3

The above phenomena are however, found to be absent when *unfractionated commercial samples* of polystyrene and polymethyl methacrylate are dissolved in benzene. This is in conformity with the result obtained in polymer fractions, namely, that the peaks and depressions occur in such a closely spaced manner for the different fractions of the same polymer. They are apparently cancelled out by superposition in an unfractionated sample.

Moreover, we have found that unlike benzene which is a good solvent, if a poor solvent like ethyl methyl ketone is chosen and measurements are made on a fraction of each of the above polymers these phenomena are not exhibited at all. This has to be attributed to the lack of freedom to the polymer molecule in a poor solvent to assume different configurations as it is then in a completely coiled state, thereby all the relaxation effects having been suppressed.

The temperature during the course of each of the above experiments has been held constant to within $\pm 0{\cdot}5^\circ$ C.

THERMONUCLEAR EXPLOSIONS AND THE WEATHER

THE poor weather experienced in the British Isles and generally in Western Europe in the summer of 1954 came soon after the announcement by the United States Atomic Energy Commission that a series of thermonuclear explosions had taken place in the Pacific. Perhaps not unnaturally, this coincidence caused speculation (unfortunately, often ill-formed and emotional) on the possibility of 'cause and effect'. An attempt has been made by Sutton (*Nature*, 1955, 175, 319) to examine objectively if any grounds exist for suspecting a unique relationship between the man-made disturbances over the Pacific and the weather of mid-1954 in other parts of the world.

Such an investigation is difficult for a variety of reasons. Weather is the first order perturbation of climate and since the weather of 1954 did not exhibit in the British Isles, any features that cannot be paralleled and even exceeded in past years, it follows that any effects attributable to the explosions must be of magnitude not exceeding that of ordinary weather-producing influences. The detection of such additional effects, therefore, demands careful statistical analysis that cannot properly be attempted until several years have elapsed, so that existing climatic 'trends' can be recognized and eliminated. An equally serious difficulty is that, so far, it is not known with certainty how many thermonuclear explosions occurred in 1954, or when and where they all occurred. From press reports it is possible to make what is thought to be a reasonable estimate of the order of magnitude of the energy release in the largest of the Pacific explosions; but almost all other details are lacking.

After examining the evidence from meteorological records, Sutton concludes that both the climatological and aerological evidence are unfavourable to the suggestion that thermonuclear explosions, so far as they are known to have occurred, ruined what might otherwise have been a fine summer. The weather experienced in the British Isles was well within the established climatic range, and taking all facts into account, it is evident that it would be exceedingly difficult, if not impossible, to establish a 'cause and effect' sequence on purely meteorological grounds. What evidence exists points, in fact, to the opposite conclusion.

FORMATION AND ACCUMULATION OF CITRIC ACID IN *ASPERGILLUS NIGER*

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STUDIES on the mechanism of citric acid formation in *A. niger* started as early as 1913 when it was detected in *A. niger* by Zahorski.[1]

Various hypotheses have been formulated for the conversion of the straight chain form of glucose into six carbon acid possessing a branched chain. But the evidence available is not conclusive enough to permit a decision in favour of any one of them. Of all the theories put forward, that of Raistrick[2] deserves discussion, as evidence has been accumulating in recent years to establish the essential principle of his theory. In 1919, Raistrick and Clark[3] suggested that the molecule of glucose, suffering a loss of the element of two molecules of water, together with oxidation at terminal carbon atoms, may give a reactive α, γ diketoadipic acid which, on hydrolysis, should yield acetic acid and oxalacetate, the aldol condensation of the two giving citric acid. Even though sufficient proof has not been obtained for the formation and detection of α, γ diketoadipic acid, recent findings indicate that C_2-C_4 condensation takes place in the formation of citric acid.

Several suggestions have been put forward regarding the C_2 and C_4 acids which take part in citric acid formation. But the recent findings of the author[12-14] suggest that active acetate and oxalacetate are the C_2 and C_4 acids which condense together to form citrate. The pathway of the formation of C_2 acid from carbohydrate is not yet well established. Several workers have felt that the Embden-Meyerhof scheme may be operating, as alcohol and C_2 acid are always found to be present together in the sugar medium in which *A. niger* is grown. But Johnson, Knight and Walker[3] showed that in the presence of 0·002 M iodoacetate, which inhibits the formation of alcohol, citric acid can be produced. Hence they felt that a pathway different from the Embden-Meyerhof scheme may occur. Recently it has been suggested that the Embden-Meyerhof scheme may continue up to the stage of pyruvate which when formed is oxidatively decarboxylated to form acetate.[4] This view has been further strengthened by the recent findings of Jagannathan and Kartar Singh[5] and Shu, Funk and Neish.[6] But Cleland and Johnson,[7] by studying the fermentation of glucose 3, 4 C^{14} by *A. niger*, have suggested a different pathway leading to the splitting of hexose into two C_3 fragments and decarboxylation of one of these C_3 fragments giving rise to C_2 acid. Even though there is sufficient evidence to prove that pyruvate is formed from hexose and that oxidative decarboxylation of pyruvate gives active acetate, the pathway of the formation of pyruvate from hexose has not yet been clearly understood.

As regards the C_4 acid, there are many pathways by which it can be formed. Recently Halliwell[8] found that by passing air with 2% CO_2, 180% citrate is formed. Further it was observed that whenever excess citric acid is formed, the ratio of CO_2 evolved to oxygen consumed is always the smallest. This suggests that Wood-Werkman reaction may be operating in *A. niger* by which CO_2 can be fixed in pyruvate to form oxalacetate. This observation is strengthened by the findings of Foster *et al.*[9] and Martin and Wilson[10] who found that *A. niger* placed on a sugar solution in presence of CO_2 labelled with radioactive carbon produces citric acid with labelled C in carboxyl groups. But the enzyme responsible for Wood-Werkman reaction has not yet been detected in *A. niger*. Similar suggestions have also been made as regards the operation of Thunberg reaction in *A. niger* in which two acetates may condense together to form succinate. But this type of reaction has not yet been established in *A. niger*, and acceptance of this theory has to wait until the appropriate enzyme is isolated and the formation of labelled succinate is confirmed using that enzyme and labelled acetate. There is a possibility of one more pathway for the formation of C_4 acid. While investigating the enzyme systems in *A. niger* during citric acid accumulation, the author observed that the concentrations of α-keto glutaric oxidase and fumarase of the mold increased several folds, and this suggests the possibility of formation of C_4 acid from glutamate.[11] Thus it seems there are many pathways for the formation of C_4 acid.

Several people suggested the occurrence of Krebs' citric acid cycle as the reason for the formation of citric acid in *A. niger*, since the intermediates of Krebs' cycle have been detected at different times. But none of them studied

the stepwise reactions of the cycle. Recently Ramakrishnan and Martin[12] studied the enzymes involved in the formation of citric acid in *A. niger* with a view to find out how far the cycle operates during formation and accumulation of citric acid in *A. niger*. The citric acid producing strain of *A. niger*, N.R.C. 233 has been grown in non-citrate accumulating medium containing malt extract, yeast extract and glucose in shake flasks for 18 hours and the mat obtained. The different enzymes have been extracted from the mat. Recently, the condensing enzyme has been isolated with a high degree of purity and it has been successfully established that the enzyme can affect the synthesis of citrate from acetyl phosphate, coenzyme A and oxalacetate according to the reaction acetyl-phosphate + coenzyme A → acetyl-coenzyme A + P; acetyl-coenzyme A + oxalacetate → citrate + coenzyme A. The condensing enzyme in *A. niger* appears to be different from the one isolated from animal tissues in that it is inhibited by Mg^{++} whereas it has been found essential for the latter.[13] It has been possible to detect the presence of all the enzymes of Krebs' tricarboxylic acid cycle in the cell free extracts of *A. niger*.[14] Thus, evidence for the operation of Krebs' cycle in *A. niger* when grown in a non-citrate accumulating medium has been obtained.

Since the medium used in these investigations is a non-citrate accumulating medium which is different from the one used in industry for large-scale production of citric acid, mold pellets from the actively fermenting molasses medium (in which citric acid is formed and accumulated) were taken out at different periods of citric acid production, the cell free extracts prepared and tested for the presence of the enzymes of Krebs' citric acid cycle. It was found that in the initial stages when no citric acid accumulated, all the enzymes of Krebs' cycle were present and as citric acid started accumulating, aconitase and isocitric dehydrogenase activities became zero. It seems Krebs' cycle enzymes are present in *A. niger* during non-accumulation of citrate and the cycle gets broken down at aconitate and isocitrate levels when citrate starts accumulating in the medium. Even though the reason for the inhibition of aconitase has not been worked out, it is found that addition of excess citrate inhibits isocitric dehydrogenase.[11] From the above discussions, it would seem logical to assume that the formation and accumulation of citric acid in *A. niger* is the net outcome of several reactions like stoppage of operation of Krebs' cycle at a definite stage. Since most of the enzymes required for all these reactions have been detected and many of them purified, it will be possible to study the reactions stepwise, using isotopic and chemical methods, and come to a definite conclusion as regards the mechanism of formation and accumulation of citric acid in *A. niger*.

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13. —, *Nature*, 1954, **174**, 230.
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'ATOMS FOR PEACE' EXHIBITION

DR. K. S. KRISHNAN, Director, National Phyical Laboratory, declared open the "Atoms for Peace" exhibition in New Delhi on March 10, 1955. The exhibition was organised by the U.S. Information Service with the help of the U.S. Atomic Energy Commission, to illustrate and explain the peaceful uses of atomic energy, depict the various phases of atomic energy development through pictorial panels and charts, miniature working models of Geiger counters, atomic reactors and atomic power plants, and practical uses of various forms of atomic energy. The exhibition will be shown in 50 towns and Universities in India during the next two years.

THE INFLUENZA VIRUS

FOR the last ten or twelve years influenza virus has been a favourite object of study for those who are interested primarily in the nature of viruses rather than in the diseases for which they are responsible. This virus has two qualities which make it particularly suitable for such studies. The first is that it can be grown very readily in the cavities of the chick embryo, the allantoic fluid of which then provides a relatively concentrated and conveniently handled form of virus. A second, and even greater, advantage to the experimenter is that the concentration of virus in such fluids can be accurately and simply titrated in the test-tube by utilizing the virus's power of agglutinating red blood cells—the hæmagglutination phenomenon of G. K. Hirst.

These properties facilitate investigations necessary to establish the physico-chemical nature of the virus particles and to determine, at least in outline, the course of their multiplication in the cell. These investigations have in fact been made, and at least as much is now known about the nature and activities of a typical influenza virus, such as the standard American strain PR 8, as about any other animal virus. As this knowledge accumulated, it gradually became clear that although the particles of influenza virus are well-defined, functional units with characteristic antigenic, enzymic and genetic qualities, chemically they cannot be differentiated from fragments of the cytoplasm of the cells in which they are parasites.

Considered apart from the specific patterns carried by the macromolecules concerned, any type of influenza virus particle is like any other, and distinguishable from a fragment of host-cell cytoplasm only by a moderate regularity of size and shape. Some of the proteins, however, have new specific patterns replacing —or perhaps additional to—the patterns characteristic of host proteins, and we can feel certain that the vital 0·8% of RNA carries a code that differs sharply from that of the cytoplasmic RNA from which it must be derived. The possibility that the large amount of lipid in the particle also has its own series of specific patterns is something that must await the emergence of the appropriate technical approach. On this view, then, the influenza virus is no more than a fragment of living matter carrying patterns—patterns which determine whether the particle is, like most laboratory strains, virulent only for the chick embryo or, at the other extreme, capable of initiating a deadly pandemic-like that of 1918. (*Endeavour*, January 1955.)

OBITUARY

PROFESSOR J. J. ASANA

WE regret to report the death of Prof. J. J. Asana, former Professor of Biology, Gujerat College, Ahmedabad, and late of the Bombay Educational Service, at the age of 64 on December 16, 1954, at Poona.

J. J. Asana was born in Broach on July 30, 1890. After taking the M.A. Degree in Baroda College, he started his career in 1915 as Assistant Professor of Zoology at the Gujerat College, Ahmedabad, where he organised the new zoological laboratory and the museum, and enriched the latter considerably by his skill in Taxidermy. He proceeded to the University of Cambridge, England, in 1922, and took the tripos in Zoology in 1924. On return he occupied himself actively with research and organised a well-equipped cytological laboratory.

Asana's scientific researches were concerned with the life-history and development of reptilia and with the chromosomes of plants, reptilia and orthopteroid insects; his extensive work on orthopteroid insects was reviewed in Demerec's *Advances in Genetics*, Vol. IV, 1951. His zeal for research was an inspiration to his students and colleagues, and he took great pride and spared no pains in making his cytological preparations himself. The latter were greatly appreciated by co-workers in the U.S.A. and Japan, with whom he carried on extensive correspondence with a view to widening the scope of his investigations. In this connexion he also took a short trip to Japan in 1937 at his own expense, and visited several important Institutes and Universities.

Prof. Asana was not only a devoted and selfless seeker after truth, but also a humanist with wide sympathies, transparent sincerity and a kindly, unassuming temperament. He donated his valuable collection of books and scientific journals to the library of the Maharashtra Association for the Cultivation of Science, Poona.

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ISOTROPIC BEHAVIOUR OF ROCKS

In an earlier paper,[1] the author found the directional variation of longitudinal sound velocities in some Indian rocks to be quite small and concluded that they are isotropic for all practical purposes. In the present investigation, using the pulse technique involving the phenomenon of total internal reflection,[2] the directional variation of both longitudinal and torsional ultrasonic velocities has been studied in a number of rocks. Table I gives the results in rock specimens whose planes are chosen to be mutually perpendicular with reference to strike (*a*), dip (*b*), and a direction perpendicular to both (*c*). V_L and V_S are longitudinal and torsional velocities in metres/sec. respectively. P_L and P_S are the corresponding percentage anisotropies.

It can be seen from the results that the percentage anisotropy is of the same order in the

Table I

No.	Rock	Locality		V_L	P_L	V_S	P_S
1	Marble	Manditog	(*a*)	5917		2846	
			(*b*)	6262	1·5	2862	1·8
			(*c*)	6160		2912	
2	Marble	Manditog	(*a*)	7360		3006	
			(*b*)	7260	1·6	3055	2·0
			(*c*)	7477		2995	
3	Quartzite	Warangal	(*a*)	5693		3203	
			(*b*)	5580	1	3092	1·5
			(*c*)	5650		3151	
4	Quartzite	Warangal	(*a*)	7123		3891	
			(*b*)	7296	2	3757	3
			(*c*)	7157		3640	
5	Quartzite	Warangal	(*a*)	6036		3578	
			(*b*)	5913	1	3500	1
			(*c*)	6036		3553	
6	Granite	Hyderabad	(*a*)	6408		2732	
			(*b*)	6210	2	2630	3
			(*c*)	6341		2830	
7	Granite	Hyderabad	(*a*)	6134		2947	
			(*b*)	6015	2	2820	3
			(*c*)	5964		2750	

longitudinal and the torsional velocities. Slight departures from perfect isotropy may be attributed to the heterogeneous nature of the rocks. The results do not indicate a maximum velocity in any one particular direction studied. Thus it is quite evident that elastically, rocks are almost isotropic and this is what one should expect if the rocks are polycrystalline aggregates; where crystallites composing the aggregate are randomly oriented.

The author expresses his grateful thanks to Professor S. Bhagavantam for his guidance in this investigation.

Physical Labs., S. BALAKRISHNA.
Osmania University,
Hyderabad, *January* 21, 1955.

1. Balakrishna, S., *Proc. Ind. Acad. Sci.*, 1953, **38**, 239.
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INFLUENCE OF METEORIC DUST ON RAINFALL

IN a recent paper E. G. Bowen[1] has sought to establish a connection between heavy rainfall and the meteoric showers. He has examined daily rainfall at Sydney for a period of 85 years and has concluded that "there is a marked tendency for heavy falls of rain to occur on certain days rather than on others, and for this pattern to be repeated year after year". By considering the rainfall data of a few other places, he has arrived at a worldwide nature of the supposed connection between meteoric showers and rainfall, *viz.*, that heavy rainfall is likely to occur 30 days ($\pm$ 2) after a meteoric shower. Further it is claimed that this phenomenon has a bearing on artificial rain-making.

Swinbank[2] and Martyn[3] have very critically examined Bowen's contention from different view-points. It is the purpose of this note to find out if the daily rainfall data of Bombay for a period of 51 years (1902-53) supports Bowen's claim. In Bombay the heaviest showers of the year will normally fall in the months of July and August. The daily rainfall for those months for the 51-year period are averaged out and graphs of date against rainfall are drawn, in a manner very similar to what Bowen has done for Sydney rainfall (Figs. 1 and 2). As can be seen from the graphs the days of heaviest fall are: July 3rd, 8th and 21st; August 1st and 7th.

According to Bowen, there should be meteoric showers round about June 3rd, 8th and 21st and July 1st and 7th. So far as it is known to us there is no meteoric shower, occurring on these dates. During the period May to August the meteoric showers are:

η Aquarids, May 6th;
δ Aquarids, July 28th.

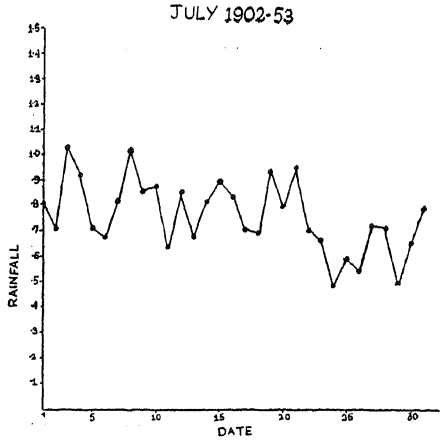


FIG. 1

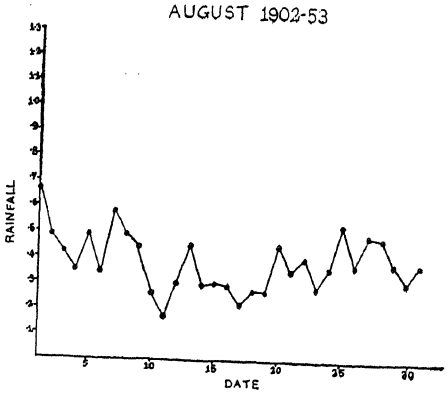


FIG. 2

The claim that many stations over a wide area show peaks similar to Sydney's on nearly the same days, is untenable, at least to Indian conditions, as January and February are about the driest months for most part of the country. This leads us to another issue, *viz.*, when meteoric showers have a significant correlation with rainfall at two or three different places on the earth, statistically there must be a correlation amongst the rainfall figures at these places. Climatologically no such relation has been established amongst rainfalls at widely different places on earth.

Meteors are commonly associated with star constellations. There is a lag of six months between the passage of the sun through a parti-

cular constellation during its apparent motion round the ecliptic and emanation of meteoric shower. No physical process can explain the long delay between the cause and the effect. No type of radiation, be it a wave or particle, can take such long time to travel this distance from sun to earth.

The author wishes to express his gratitude to Mr. S. L. Malurkar for suggesting the work and for his helpful criticism.

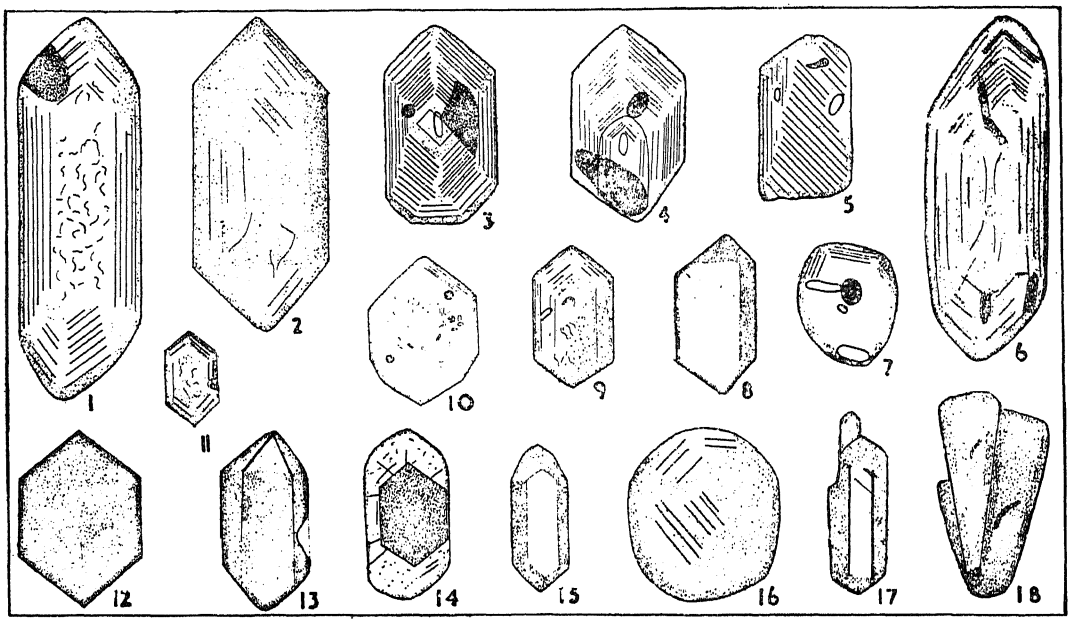
Colaba Observatory, K. S. RAJA RAO.
Bombay-5, *January* 24, 1955.

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2. Swinbank, W. C., *Ibid.*, 1954, **7**, 354.
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ZIRCON IN BUNDELKHAND GRANITES AND ASSOCIATED ROCKS

THIS paper deals with the variation in habit, size and micro-structure of zircon found in the Bundelkhand granites, associated gneisses, xenolithic quartzites and schists from Mahoba (Lat. 25° 18′, Long. 79° 53′) and adjacent areas in the Hamirpur District, Uttar Pradesh. Misra and Mathur[1] have recorded the presence of apatite, biotite, chlorite, epidote, garnet, hornblende, ilmenite, magnetite, pyrite, rutile, sphene and zircon in the heavy residues of granites and gneisses of Mahoba and Kabrai. Further studies have also revealed the presence of allanite, fluorite, kyanite and tourmaline.

The zircons are colourless, dusky, pale yellow, mauve and pale brownish. Colourless forms are most common followed by dusky variety. Coloured types are infrequent. Usually the zircons are euhedral with perfect development of the various crystal faces. Commonly they show a combination of second order prisms with first order pyramids but first order prisms are not infrequent. Crystals are often much modified by the development of steep pyramidal faces (Figs. 10 and 15). Often the basal planes are also developed in addition to the pyramids. The basal planes may develop on one (Fig. 3) or both of the terminal ends of the grain.



FIGS. 1–18

Fig. 1. Colourless zoned zircon, × 160. Fig. 2. Colourless zoned zircon, × 198. Fig. 3. Colourless zoned zircon with (001) developed at one end, innermost zone a rectangle, × 184. Fig. 4. Colourless and zoned zircon crystal having inclusion of a zoned zircon which in its turn has a prism of zircon as inclusion, × 92. Fig. 5. Colourless zircon with inclusions of needles of zircon arranged parallel to one of the prism and a pyramid face, × 190. Fig. 6. Colourless zoned zircon, × 196. Fig. 7. Dusky zoned rounded zircon containing inclusion of a globular magnetite and two prisms of zircon, × 193. Fig. 8. Colourless unzoned zircon, × 96. Fig. 9. Colourless unzoned zircon, × 100. Fig. 10. Colourless zircon with additional steep pyramids, × 54. Fig. 11. Colouress zoned zircon, × 98. Fig. 12. Dusky zircon, × 126. Fig. 13. Colourless zircon with first order prisms, × 101. Fig. 14. Zircon with an inclusion, × 157. Fig. 15. Zircon with additional steep pyramids, × 57. Fig. 16. Rounded dusky zoned zircon, × 159. Fig. 17. Zircon aggregate in pale yellow variety, × 196. Fig. 18. Zircon aggregate in light brown variety, × 198.

Sometimes prismatic grains with apparently rounded terminations reveal the presence of short pyramidal faces. Among the rounded zircons the dusky variety predominates.

There is great variation in the size of the grains. The length-breadth ratio also varies considerably. It is highest in zircons of granites (3 : 1) and lowest in quartzites and schists (10 : 9). Admixture of grains with high and low 1/b ratios is invariably found but high 1/b ratio zircons predominate in granites while they are subordinate in quartzites and schists. Crystal aggregates (Figs. 17 and 18) have also been noticed. In one of them (Fig. 17) three grains of the pale yellow variety have fused together along their prism faces. Some of the grains are full of minute fractures.

A large number of zircon grains have numerous inclusions of needles of zircons, irregular grains of sphene and opaque clots of iron ores. Zoned zircons have, as a rule, a larger number of inclusions. Fig. 7 shows an oval inclusion of magnetite in a zoned zircon. In some cases zoned crystals show small crystals of zircon (themselves zoned) as inclusions, which in their turn carry another small inclusion of zircon (Fig. 4). Generally, the inclusions are irregularly distributed in the host grain but often they show regular crystallographic orientation. Sometimes the needles do not follow the entire crystal outline and are equally developed parallel to a pyramid face and a prism face (Fig. 5). Sometimes they are parallel to the prism face only. All the zoned zircons show a peculiar phenomenon of change in relief when the stage of the microscope is rotated. The relief is highest when the long axes of the grains are parallel to the vibration direction of the lower nicol, while at a position at right angles to this it is very difficult to make out the individual zones. Hutton[2] who observed this phenomenon thinks that it may be due to a difference in the refractive indices of the zones and the host grains. Usually the zoning is marginal but it is also present in the central portions of the grains, with all the zones parallel to the crystal outline. The zones parallel to the pyramidal faces usually meet at right angles. An extraordinary case has been observed where the innermost zone unlike other zones is a rectangle (Fig. 3). This may be due to the absence of needles developed parallel to the prism faces and since the needles parallel to the pyramidal faces meet at right angles, the north and south set of these needles meet each other in the centre to form the rectangle.

I am highly indebted to Dr. R. C. Misra for his guidance and helpful suggestions.

Dept. of Geology, P. C. MATHUR.
University of Lucknow,
Lucknow, *December* 14, 1954.

1. Misra, R. C. and Mathur, P. C., *Proc. 40th Ind. Sci. Congr.*, 1953, Pt. 3, 9.
2. Hutton, C. O., *Bull. Geol. Soc. Amer.*, 1950, **61** (7), 635.

INTERPENETRATION TWIN IN PLAGIOCLASE FELDSPAR

EXAMINATION of thin sections of the dolerite dykes from Closepet area, Bangalore District, under the microscope revealed the presence of interpenetration twins in the plagioclases. Of about 20 dykes in the area, not less than 8 showed porphyritic texture with glassy or aphanitic ground mass—subophitic to ophitic textures not being uncommon. It is in these dolerites with a glassy ground mass that the interpenetration twins in the plagioclases are more well developed. Specimens taken at the chilled margins, which are more glassy than those taken at the centre, showed well developed interpenetration twins. Such interpenetration twins were scarcely noticed in plagioclases of more crystalline and coarse-grained types.

The occurrence of interpenetration twins in plagioclases has been reported by Masao Gorai.[1] Other reports of such occurrences could not be found in the literature accessible to the author. The interpenetration twin herein described is from a dolerite with a glassy ground mass near the first milestone of the Closepet-Kankanhalli Road. The dyke is 4′ in width and 200′ in length, and cuts across the pink porphyritic granite in N. 50° W. direction. The plagioclases are labradorites of composition 54-58% anorthite set in a glassy ground mass, augite also occurring as a phenocryst.

The two individuals that constitute the twin cross each other at 90° (as in Fig. 1) forming cruciform twins as in the case of staurolite. The twin laws of each individual, the twin plane, as well as the anorthite content were determined on the universal stage according to the method of Reinhard. In other cases, individuals also cross and interpenetrate each other at various angles.

The individuals 1 and 2 (shown in Fig. 2) are twinned after the carlsbad law, 2 and 2′ after the albite law, and 2′ and 1 form an albite-carlsbad complex. The individuals 3 and 4 are related to each other according to

the albite law. The pole of the plane of association (marked AP in Fig. 2) of the four



FIG. 1
Nicols Crossed, × 90.

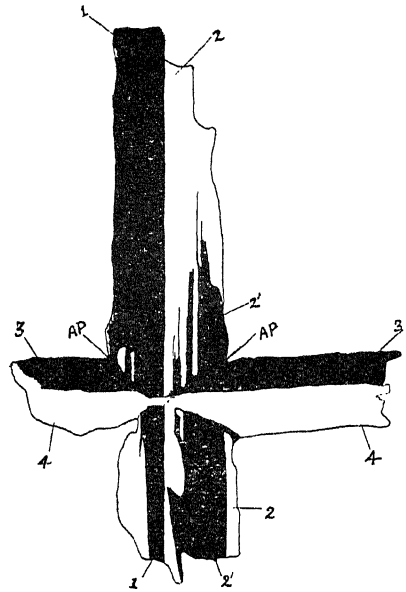


FIG. 2

arms falls on 021 curve of plate 2 of Reinhard, and therefore the association plane is parallel to 021. The poles of the association faces in other instances do not fall on any curve of Reinhard, and may be concluded as being parallel to an irrational pyramid.

Of the four types of twinned plagioclases described by Gorai, penetration twins fall under type 4 of C-twin groups. C-twins, which include albite, carlsbad, and albite-carlsbad laws, are characteristic of volcanic and plutonic igneous rocks, and the plagioclases under study in these dykes are mostly twinned after these laws. The interpenetration twin is often noticed in the chilled dykes of Closepet area. In this area, therefore, the penetration twin in plagioclases appears to be more characteristic of volcanic than of plutonic rocks, as the dykes under study, on account of their chilled nature, have developed under conditions similar to those attained in the volcanic mode of origin of rocks.

Study of twin laws in plagioclases from all the dykes of the area is under progress, and a more detailed account of it will be published elsewhere.

The author is grateful to Dr. P. R. J. Naidu for guidance and to Dr. M. G. C. Naidu for helpful suggestions.

Dept. of Geology, K. V. SURYANARAYANA.
Central College,
Bangalore, *January* 15, 1955.

1. Masao Gorai, *Amer. Min.*, 1951, **36**, 884.

A SIMPLE LABORATORY ATOMISER FOR PAPER CHROMATOGRAPHIC WORK

THE design and working of an all-glass atomiser for spraying chromatographic reagents is given below.

The construction of the atomiser is shown in Fig. 1. The nozzle B (3·5 cm. in length) ends

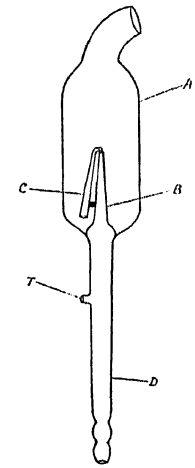


FIG. 1

in an orifice of about 1 mm. A similar small tube C (1 mm. bore and 3·5 cm. in length) is bent at right angles and attached to B by a

glass bead. The bent end of C faces the tip of the orifice B and almost touches it. This unit is sealed to a glass bulb A of about 25 ml. capacity. About 10 ml. reagent can be introduced into the chamber.

Compressed air is blown from the bottom tube D. The pressure of the air current can be regulated through the side outlet T by closing it with the thumb. When the air is forced out of the orifice, the tube C sucks the liquid present in the chamber and the air-jet atomises the liquid drop. A fine spray issues continuously through the mouth of the bulb A. The present model effects economy of the reagent and even corrosive reagents can be sprayed as the atomiser is of all-glass construction. The sprayer is simpler and less expensive than the conventional atomisers of the 'Concentric' and the 'Right-angled' types described in literature.

The authors wish to express their grateful thanks to Prof. K. R. Krishnaswami for his kind encouragement and advice.

S. K. SATYANARAYANA.
A. R. VASUDEVA MURTHY.

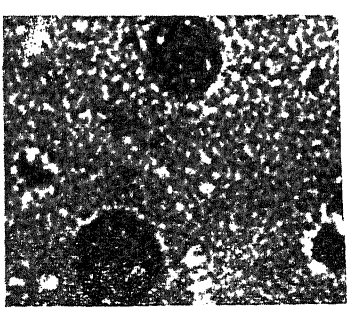
Dept. of Gen. Chem.,
Indian Inst. of Science,
Bangalore, *January* 24, 1955.

A BACTERIAL DISEASE OF *HELIOTHES OBSOLETA* F.

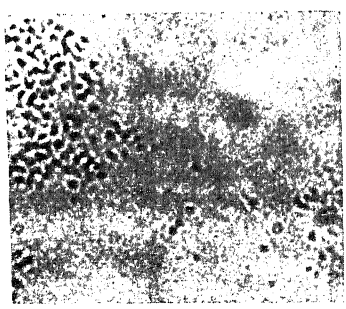
A SEVERE attack of *Heliothes obsoleta* F. (Lepidoptera) was noticed in the *Dolichos lablab* crop of 1953-54 around Mysore. A close survey revealed a large number of the insect larvæ dying due to a disease in these fields. The symptoms of the disease comprised of the normal green colour changing to pink, the body becoming soft and limp and the dorsal blood vessel becoming conspicuous. The disease was investigated with a view to employ it in the control of the insect.

To know whether the disease was caused by some micro-organisms a large number of healthy and diseased caterpillars were surface sterilized and their different body parts were examined. The blood of the diseased insects showed the presence of a bacterium in it which could not be observed in the healthy ones. This bacterium was therefore isolated by the usual bacteriological methods. Subcultures were made on nutrient agar slants and nutrient broth incubated at 31° C. for 48 hours. The pathogenicity of the bacterium was then tested by suspending it in physiological saline solution and spraying the suspension on *D. lablab* pods in the laboratory. These tests were carried out under aseptic conditions. The healthy larvæ feeding and moving on the treated pods showed symptoms of the disease in 48 hours and died in 72 hours. The bacterium could be recovered from the blood of the larvæ exposed to the treated pods. Later tests showed that contact of healthy larvæ with the diseased ones also could produce the disease in the healthy ones. These demonstrated that the disease was caused by a bacterium and that it is contageous.

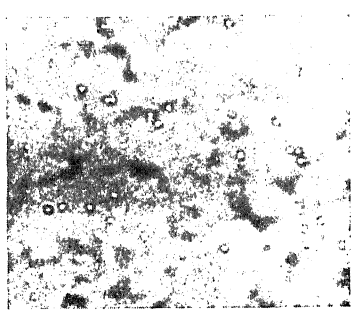
A series of microtome sections (6-8 μ thick) of the diseased and the healthy caterpillars were prepared, to know the way in which the bacterium brought about the death of the insects. The larvæ were killed with ether, fixed in Bouin's fluid for 24 hours, washed with water, passed through alcohol grades, cleared in ceder wood oil and xylol and embedded in paraffin (m.p. 48° C.). The sections were stained by the Glynn's gram stain method.[1] The examination of these sections showed that the bacterium attacked the hæmocytes. This resulted in the rupture of the hæmocytes and when most of them were destroyed the larvæ died (Figs. 1, 2, 3).



1



2



3

FIG. 1. Blood of healthy *H. obsoleta* showing hæmocytes, × 750. FIG. 2. Hæmocytes in the blood ruptured as a result of the attack by bacteria, × 750. FIG. 3. Hæmocytes of the blood destroyed and the bacteria freely multiplying in the septicemic blood, × 750.

The bacterium is gram positive, motile, rods in chain and sporulating. Studies on the identification of the organism are in progress and will be reported shortly.

Bacterial control of insects is being investigated recently. The works of Hall[2] relate to the high susceptibility of the Sod webworm (*Crambus mutalibilis* Cl.) to *Bacillus thuringiensis* and of Philips *et al.*[3] to the susceptibility of the codling moth (*Carpocapsa pomonella* L.) to *B. cereus*. From India, mycoses in insect pests are reported[4,5] but not the bacterial diseases. The above work suggests the possibility of controlling *H. obsoleta* by employing bacteria.

The authors' thanks are due to Dr. V. Subrahmanyan, for his help and interest in the work.

Central Food Tech. Res. Inst., Mysore,
November 5, 1954.

S. K. MAJUMDER.
M. MUTHU.
S. V. PINGALE.

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PROLIFERATION IN THE INFLORESCENCE OF *ECHINOCHLOA CRUS-GALLI* BEAUV.

Echinochloa crus-galli Beauv. belongs to the *Paniceæ* of the family *Gramineæ*. The specimen showing the abnormality regarding proliferation of the rachilla or the inflorescence axis of the spikelet, was collected from the rice field of the State Agricultural Research Station, Chinsura, West Bengal, by the author during the second week of October 1953.

Here in the normal spikelets (Fig. 1) which are two-flowered (containing upper and lower

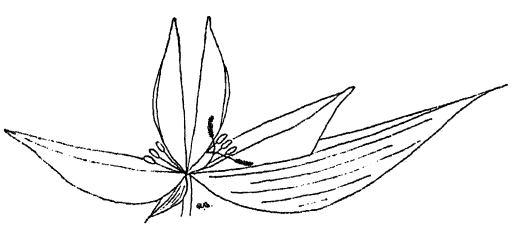


FIG. 1. A normal 2-flowered spikelet shown in detail.

florets), the lower floret is male consisting of 3 stamens. The two empty glumes, lower and upper (Glumes I and II) are very dissimilar and undulated. The lower floret is paleated. The upper floret is hermaphrodite, beyond which the rachilla is not produced.

The abnormal entire inflorescence of this grass resembles the normal one in all respects except that it bears in place of certain spikelets one long, one medium and three small proliferated spikelets. These shoots are described as propagules or proliferations which project out quite conspicuously from the axis of the inflorescence. The size of the shoots varies from 6-21 mm. and maximum number of proliferated spikelets observed here is five. When the medium-sized proliferated spikelet was dissected (Fig. 2), it was observed that the struc-

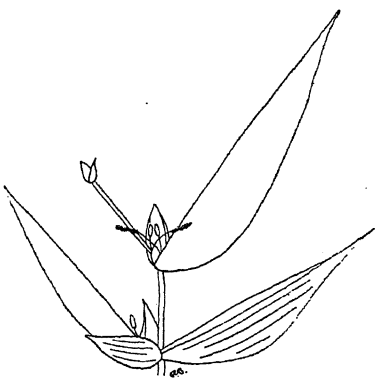


FIG. 2. A proliferated spikelet showing the proliferation of the rachilla beyond the upper floret.

tures and their positions of insertion in the rachilla were the same as that of the normal one, excepting that they have increased considerably in size, forming leaf-like structures in appearance but without any leaf-sheath or ligule. The lower floret consists of one stamen and the upper one consists of two stamens and the pistil with feathery stigma. The rachilla was elongated and measured about 2·2 mm. It was produced beyond the upper floret measuring about 2·5 mm. It was terminated by a flower bud.

The abnormalities described here consist of vegetative shoots developing in place of spikelets. This phenomenon was interpreted differently by different authors.[1-5,8] As the abnormal spikelets were very few in number and were found only in one inflorescence out of six tillers of the plant, no systematic investigation could be done to find out the cause or causes of the proliferation. But, according to Arber,[1] proliferations are of two types—one is brought about by environment and the other

by chromosomal and hereditary causes. Nielson,[6] Reeves and Stansel,[7] however, viewed this as due to environmental factors only. Very recently Wycherley[8] has stated that the degree of floral and vegetative development is conditioned by the concentration of a flower-inducing hormone F (or the intensity of some condition), at the time of initiation and differentiation of the inflorescence organs.

Proliferation of this type gives an indication that the spikelets have the tendency of becoming many flowered with the continuous elongation of the axis beyond the upper floret like that of the *Hordeæ*, the *Triticeæ*, etc. The present is perhaps the first report of an abnormality in *E. crus-galli* Beauv.

State Agric. Res. Station, R. K. BHATTACHARYYA.
Chinsurah, Hooghly,
West Bengal, *July* 20, 1954.

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SOME NEW HOSTS OF *CEPHALEUROS* FROM BIHAR

SOME hosts of *Cephaleuros*, new to Bihar, were reported previously by the author.[1] Since then some more collections of the alga have been made both on wild and cultivated plants from different parts of the State. The hosts collected have been deposited in the mycological herbarium, Botany Department, Patna University.

A careful study of well stained hand-cut sections revealed that the alga on *Aganosma caryophyllata* G. Don. is parasitic as a portion of it is intramatrical. But in the case of the hosts recorded below, the alga is only epiphytic, using the leaf-surface merely as support, though of course in severe cases when the foliage is heavily covered with algal lesions, it may induce rapid defoliation.

PATNA.—*Ficus nervosa* Roth., *Sterculia alata* Roxb., *Cassia fistula* L., *Ficus religiosa* L., *Bombax malabaricum* Dc., *Cæsalpinia crista* L., *Morinda tinctoria* Roxb., *Zizyphus jujuba* Lamk., *Erythrina suberosa* Roxb., *Artocarpus integrifolia* L., *Pyrus malus* L., *Lagerstrœmia indica* L., *Tectona grandis* L., *Tecoma stans* L., *Eriobotrya japonica* Lindl., *Dalbergia latifolia* Roxb., *Trewia nudiflora* L.

PURNEA.—*Bauhinia variegata* L., *Ficus benghalensis* L., *Morus alba* Bureau,

BHAGALPUR.—*Cassia javanica* L.

PARASNATH HILLS.—*Nyctanthes arbor-tristis* L., *Combretum decandrum* Roxb., *Bassia latifolia* Roxb., *Ixora undulata* Roxb., *Buchanania latefolia* Roxb.

The author wishes to express his grateful thanks to Dr. R. P. Roy for giving necessary facilities and Sri. J. G. Srivastava for kindly identifying a number of hosts.

Dept. of Botany, A. S. YADAVA.
Patna University,
Patna, *January* 22, 1955.

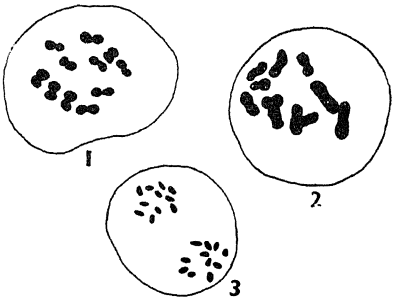
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BASIC CHROMOSOME NUMBER OF *LANTANA CAMARA* L.

Lantana camara L. is a native of tropical America. According to Duthie,[1] the plant appears to have been introduced into Ceylon about the year 1824, and from there to have spread throughout Peninsular India and northwards as far as Dehra Dun. The plants of *Lantana camara* L. are characterized[1, 6] by the presence of recurved prickles on the stem, short capitate spikes which appear subumbellate when young, lanceolate bracts, 3-5-ribbed stem and a strong smell of black currant. The plant whose chromosome number is being reported in this paper has all these characters except that the stem of this plant has small prickles which are sparingly present. According to Haines,[5] some forms of *Lantana aculeata* (= *Lantana camara* L.) have very minute prickles and according to Bailey,[6] some types of *Lantana camara* L. may even be unarmed or slightly prickly.

The basic chromosome number (x) is the lowest haploid number in a polyploid series. Singh[7] reported the haploid (n) number of *Lantana camara* L. as 22. Sen and Sahni[8] noted the natural occurrence of triploids ($2n = 33$), tetraploids ($2n = 44$) and pentaploids ($2n = 55$) in the same species. The presence of a plant with $2n = 22$ in this species has not been reported. While studying meiosis in *Lantana camara* L., the authors found a plant which at diakinesis showed 11 bivalents (Figs. 1 and 2). The distribution of the chromosomes at anaphase I was regular and 11 chromosomes at either pole were clearly seen (Fig. 3). This

plant with $n = 11$ has the lowest haploid number in the naturally existing polyploid series of *Lantana camara* L. Our findings thus show that the basic chromosome number (x) of *Lantana camara* L. is 11. In view of these



FIGS. 1. (× 713) and 2 (× 1,125). Diakinesis showing 11 bivalents. FIG. 3. (× 713). Anaphase 1 showing 11 chromosomes at each pole.

findings the plant with $n = 22$, as reported by Singh,[7] must have been at a tetraploid level. The existence of a naturally occurring polyploid series in *Lantana camara* L. may be either due to the original introduction of the different chromosome races of this species or that the plants of *Lantana camara* L. may have undergone natural variation and evolution in India. Patermann[9] reported the chromosome number of *Lantana trifolia* L. as $n = 24$. In view of the present report of the basic chromosome number of *Lantana camara* L. as 11, the presence of a species with $n = 24$ in the genus *Lantana* indicates that this genus has either more than one basic chromosome number or the presence of aneuploidy.

We are grateful to Prof. P. Maheshwari for having gone through the manuscript and for his useful suggestions.

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University of Delhi, A. SHEILA CHANDI.
Delhi-8, *January* 19, 1955.

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INFLUENCE OF THE CULTURE FILTRATE OF *FUSARIUM VASINFECTUM* ATK. ON *PIRICULARIA ORYZAE* BR. ET CAV.

THE presence of a thermostable growth-promoting factor as one of the metabolites of *Fusarium vasinfectum* Atk. in culture has been shown by the rooting of cut shoots of cotton in dialysed and autoclaved culture filtrate of the fungus.[1] The dialysed and autoclaved culture filtrate from the same strain of *F. vasinfectum* was added to 50 ml. of Richard's liquid medium (adjusted to pH 6·0) and inoculated with an isolate of *Piricularia oryzæ*, known to be heterotrophic to thiamine and possessing complementary deficiency for biotin.[2] The cultures were incubated at 27-28° C. for three weeks. Increased growth over the control was recorded which, however, was less than that obtained in Richard's liquid medium with added thiamine (Table I).

TABLE I

Treatment	Mat weight in mg. of *P. oryzæ* at the end of three weeks (Average of three replicates)
Culture filtrate of *F. vasinfectum* added to Richard's medium	130·0
1·0 µg. of thiamine + Richard's medium	263·0
Control (pure Richard's medium)	Nil

Although not strictly comparable, it is suggestive of the possibility of the dialysed and autoclaved culture filtrate of *F. vasinfectum* having thiamine replacement value—a point of considerable interest in understanding the physiology of fungi autotrophic and heterotrophic to B vitamins.

We are indebted to Prof. T. S. Sadasivan for guidance and to Dr. C. V. Subramanian and Shri K. Lakshminarayanan for suggestions.

Botany Lab., A. APPA RAO.
University of Madras, N. S. SUBBA RAO.
Madras-5, S. SURYANARAYANAN.
February 2, 1955.

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ENDOPHYLLUM SPECIES ON *ELAEAGNUS LATIFOLIA*

Aecidium elœagni-latifoliæ Petch, parasitising the leaves of *Elœagnus latifolia*, is widely distributed in the hilly tracts of Mahableshwar, Bombay State.[3] The rust incites the formation of pale yellow patches on the upper leaf-surface, bearing white æcial pustules on the lower leaf-surface. Owing to the metallic lustre of

the silvery scales on the lower leaf-surface, the white æcial pustules are often inconspicuous in the field. During the heavy monsoon rains in Mahableshwar from June to September (over 250") the æcial pustules are not well developed, but only scattered infection spots are observed. From November onwards, the pycnial stage begins to appear conspicuously on the upper leaf-surface as tiny orange specks, followed by æcial formation, which may be abundantly seen from February to May.

Pycnia are subepidermal, honey-yellow, flask-shaped, ostiolate, with poorly developed periphyses. The æcia are telioid, subepidermal, erumpent, white, peridiate, developing chains of hyaline spores. The peridia are strongly developed, reflexed, the cells being densely rugose, measuring 25-32 × 19-20 μ. The æciospores are subglobose to polygonal, densely verrucose, measuring 15-24 × 12-19 μ.

The æciospores germinate readily developing promycelia and sporidia, thus pointing out that the rust is a species of *Endophyllum*. Spore germination is considerably influenced by temperature. The spores germinate best between 70-85° F. developing promycelium and sporidia. Above 85° F., germination is abnormal, developing a septate germ tube with irregularly lobed contour. Spore material stored at room temperature (60-90° F.) loses its viability after a week.

Sporidial inoculum prepared by germinating æciospores was used for inoculating young unfolding leaves of *Elæagnus latifolia*. The inoculated plants were incubated in moist chambers for 24 hours after which they were placed in the green-house for further observations. Successful infection became evident after 15 days by the development of yellow spots enlarging into patches. Pycnial formation was observed nearly after a month.

The germination studies have indicated that the rust previously designated *Aecidium elæagni-latifoliæ* Petch[1,2] on *Elæagnus latifolia* is a species of *Endophyllum*. Therefore, the new combination *Endophyllum elæagni-latifoliæ* (Petch) Gokhale, Thirumalachar and Patel is proposed for its accommodation.

Agric. College, Poona,
February 2, 1954.

V. P. GOKHALE.
M. J. THIRUMALACHAR.
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THE DIGESTIVE ENZYMES OF *BANKIA INDICA* NAIR

WHILE the physiology of digestion and the digestive enzymes have been studied in a number of molluscs, our knowledge regarding those of the wood-boring molluscs of the family Teredinidæ is meagre, being confined to the detection of amylase and cellulase in the digestive diverticula of Teredo[1] and Bankia.[2]

Since it has been shown by many[3-5] that the diet of the shipworms is mainly the wood which they bore into, it would be interesting to study their digestive enzymes. The present note deals with the results of a series of experiments conducted to determine the nature and action of the digestive enzymes of *Bankia indica*, the commonest of the shipworms infesting the fishing floats in the Madras waters. Acetone dried and distilled water extracts were made, using the digestive diverticula and crystalline style, as per standard methods.[6] The activity of the enzymes on carbohydrates was determined by methods used by Yonge[7] and Somogyi.[8] The products of protein digestion were estimated by Sørensen's formol titration method and products of fat digestion by the direct titration of the fatty acid formed with sodium hydroxide solution using phenolphthalein as the indicator. The cellulolytic activity of the style was studied by using regenerated filter-paper, prepared by the method of Scales[9] and the utilisation of cellulose was followed turbidometrically in photoelectric absorptiometer. In all enzymic experiments the pH of the medium was controlled by suitable buffers, *viz.*, Sørensen's M/15 phosphate buffer pH 5·3 to 7·7 for carbohydrates, M/10 citric acid, M/5 sodium phosphate buffer of McIlvaine, pH 3 to 6·6 followed by 0·2N phosphate-sodium hydroxide buffer of Britton and Welford pH 6·6 to 12·2 for protein and the method adopted by Nicol[10] for fat digestion. The temperature was maintained by an electrically controlled thermostat.

The results of these experiments showed that the digestive enzyme system of *Bankia indica* is effective on carbohydrates, fats and proteins. It was found that the digestive diverticula contain a strong enzyme system which can hydrolyse a variety of carbohydrates like starch, glycogen, sucrose, maltose, lactose, cellobiose, gum arabic, saw dust and regenerated filter-paper more in an acid medium (pH 5·9 to 6·5). The activity-pH curve when plotted for the action of amylolytic enzyme showed that the digestive activity is at its maximum at pH 6·2. The optimum temperature for amylase activity is about 33° C. A series of experiments to deter-

mine the relation between duration of the experiment and optimum pH showed that the pH at which digestion is optimum is not altered when the period of incubation is continued from 5 to 10 and 16 hours. Further, it was observed that variation in the temperature (24° C., 32° C., 42° C.) does not affect the optimum pH for starch digestion. Amylase is found to be destroyed between 60 and 65° C. However, cellulase is destroyed at about 70° C.

Similar experiments showed the presence of a strong amylase (optimum pH 5·9), glycogenase and cellulase, in the crystalline style. The lipolytic enzymes present in the digestive diverticula of *Bankia* which is principally a wood feeder are weak compared with those of typical plankton feeders, but are capable of acting on a wide range of lipids like lecithin, olive oil and methyl acetate. Thus there is a definite correlation between the nature and strength of the digestive enzyme and the feeding habits of the animal. The optimum pH of the lipolytic enzyme is found to be 7·3 and the enzyme is destroyed at 65-70° C.

The protease present in the extracts of the digestive diverticula though weak as in other lamellibranchs, is capable of splitting different types of proteins (gelatine, fibrin, peptone, casein) into simpler amino acids. The results of experiments with gelatine as substrate showed that the protease possesses two optimal pH values, pH 4·6 and pH 8·5 which are in close accordance with the results on the protease of *Ensis siliqua* by Graham.[11] The protease is destroyed completely at 70° C.

Filter-paper chromatographic detection of the end products of cellulose degradation by enzymic action by spotting the hydrolysate, when developed at 100° C. for 5-7 minutes with benzidine developer,[12] the migrating solute appeared as brown spots of varying intensity and demonstrated the concentration of sugars present. After developing the chromatogram the R_f of each spot produced by the unknown was compared with those of known sugars. Cellobiose and glucose were easily detectable in the hydrolysate indicating cellulase activity.

A fuller account will be published elsewhere.

My thanks are due to Prof. C. P. Gnanamuthu, for suggesting the problem and to Prof. P. S. Sarma and Dr. E. R. B. Shanmugasundaram of the Biochemistry Laboratory for facilities and guidance during this work.

University Zool. Lab., N. Balakrishnan Nair.
Chepauk, Madras,
November 28, 1954.

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AN ABNORMALITY IN THE ARTERIAL SYSTEM OF *RANA HEXADACTYLA*

In one of the dissections of the arterial system of *Rana hexadactyla* carried out in the laboratory, an interesting case of abnormality was observed revealing the following features: (*i*) The whole truncus arteriosus turned to the left and gave off the usual arches of that side with no arch to the right (Fig. 1). (*ii*) The

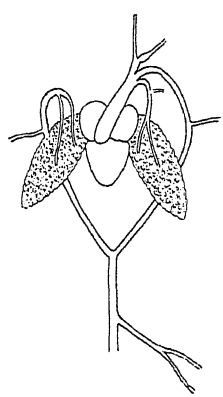


FIG. 1

systemic arch, nevertheless, was present on the right side associated as usual with the sympathetic nervous system and the subclavian artery.

This anomaly may be due to abnormality in the changes of the arterial system during metamorphosis. It is possible that the fourth (systemic) aortic arch of the right side lost its connection with the heart. The sixth (pulmonary) aortic arch, while losing its connection with the heart, retained its connection with the fourth arch (systemic); *i.e.*, the ducts arteriosus of the right side is persistent in the adult.

That there is a regular pulmonary circulation on the right side is evident from the normal condition of the right lung. This may be made possible by the flow of blood into this organ through the abnormal systemic which in turn is supplied by the systemic of the other side. The forward flow of blood in the right systemic is not impossible in the absence of flow into it from the heart and in the absence of valves in arteries in general. The blood supplied to this lung, of course, is drained by the right tributary of the pulmonary vein.

I am thankful to Mr. P. K. Menon, of the Presidency College, for valuable suggestions in arriving at this explanation.

Zoology Dept., B. N. RAMAMURTHI.
Loyola College, Madras-6,
January 18, 1955.

OCCURRENCE OF *SILLAGO CHONDROPUS*, BLKR., IN THE SEAS OF INDIA

AMONG the principal estuarine fishes of our coast, the family Sillaginidæ has been so far represented by three species, namely, *S. panijus*, Day, *S. maculata*, Quoy and Gaim, and *S. sihama*, Forskal, as recorded by Day.[1] Of these, *S. panijus* is known to occur in shoals along the Coromandel coast, in the Ganges, in Burma and in the Malay Archipelago. *S. maculata* has a wide distribution in the Indo-Australian Archipelago, occurring along Andamans, East Africa, New South Wales, West Australia, Philippines and China. Herre[2] has recorded this species from the Long Island and Middle Andaman. *S. sihama*, known as the Indian whiting, being common in the seas of India, is also widely distributed from the Red Sea to East Africa, Queensland, Solomon Islands and Japan north to Tokyo and Philippines. All these species occur in seas and estuaries and can, therefore, tolerate considerable variations in salinity.

In the State of Bombay, *S. sihama* is the only species of this genus known for its common occurrence. Since 1950, studies on the biology of this species have been undertaken, particularly in the North Canara Zone of the Bombay State, where it is caught in relatively large numbers, especially during the south-west monsoons, *i.e.*, from July to October.

In the course of this investigation a dozen specimens resembling *S. sihama* were obtained in the shore-seines 'Rampani' and 'Yendi' as locally known, operated at Binge and Arge, fishing villages in the vicinity of Karwar. These, from their general appearance, could easily be assigned to the family Sillaginidæ. A critical examination with reference to their general anatomy, body measurements and fin-ray counts, however, reveals that they differ from *S. sihama* and also from the other two species referred to above in certain fundamental characters in which they conform to those of *Sillago chondropus*, Blkr. This species has not been recorded so far from Indian waters.

The main distinguishing features, in which the specimens under discussion are found to differ from *S. sihama* and to agree with *S. chondropus* are the following:

1. Eyes comparatively smaller in diameter;
2. Air-bladder absent;
3. The first spine in the paired pelvic fins thickened and consolidated with the first ray;
4. The first hæmal arch invariably found on the 13th vertebra (usually on the 15th in *S. sihama*).

Bleeker (1849) described three specimens of *S. chondropus*, measuring 134-244 mm. in length, from the Java (Batavia) sea and Weber and De Beaufort,[3] a single specimen, 135 mm. in length from Nias. The present specimens, varying within a wide range of 158-304 mm. in total length, are the first record of *S. chondropus* from the Indian waters.

The variations in body measurements and all other details will be discussed in a separate paper.

Dept. of Zoology, V. C. PALEKAR.
Institute of Science, D. V. BAL.
Bombay-1, *January* 20, 1955.

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THE VASIFORM ORIFICE OF ALEURODIDAE

THE most characteristic organ of the Aleurodidæ is the vasiform orifice located on the dorsal surface near the posterior end of the abdomen. It is a regular feature in the four larval instars, the pupæ as well as the adults of all species of the group. Consequently it is an important character of taxonomic value.

The form, size and position of the vasiform orifice is extremely variable, not only in the different species of the family but also among the several instars in the life-history of an individual. To mention only two examples, the

pupal case of *Dialeurodes rotunda*[1] has a small sub-semi-circular orifice with a similarly shaped operculum, entirely filling the orifice and obscuring the lingula, the tip of which may rarely be seen (Fig. 1). Whereas, in *Pealius misræ*[1] the vasiform orifice is sub-trapezoidal, continued caudad considerably and with a characteristic linear sculpture. Operculum is sub-rectangular, filling about three-fourth of the orifice proper; lingula cylindric with a swollen, lobed and setose distal end visible caudad of the operculum (Fig. 2).

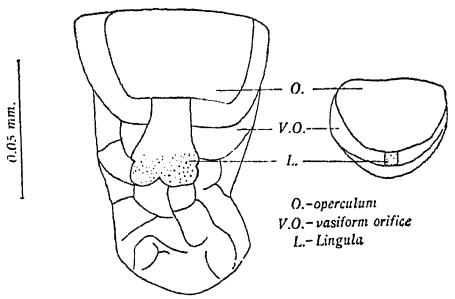


FIG. 1 FIG. 2

FIG. 1. Vasiform orifice of *Dialeurodes rotunda* (Singh), dorsal view.

FIG. 2. Vasiform orifice of *Pealius misæ* (Singh), dorsal view.

There has been considerable difference of opinion regarding the morphology and function of the orifice. It is not an opening as believed by Imms[2] and Tullgren[3]; and it has nothing to do with secretion as postulated by Peal[4] and Bemis.[5] Its structure in the pupal and adult stages is essentially the same as shown in the larva of *Dialeurodes eugeniæ*.[6] Though called an orifice, it is merely a depression in the middle of the last but two segment of the abdomen. The floor of the depression remains in an unchitinized and elastic condition. The so-called sculpturing is merely the folds and creases of this membrane, which appears to be highly extensible. The vasiform orifice should therfore be more appropriately called the vasiform membrane. The operculum and the lingula are the last two reduced abdominal segments, lodged within the vasiform pit, the anal opening being located between the two on the dorsal side. The anus has thus shifted forwards in these insects. The opercular segment is provided with levator, depressor and rotator muscles, which impart considerable mobility to it. The disposition of these muscles, along with the elasticity of the vasiform membrane, ensures the forceful ejection of the liquid or semi-solid fæcal matter in different directions, away from the body of the animal. The variability of the vasiform membrane, operculum and lingula in different individuals may be related to the viscosity of the fæcal matter. There is no doubt that the vasiform membrane with the associated structures is an efficient mechanism for the defeciation of these insects. A full account of the pupal anatomy of one of these forms will be published elsewhere.

Dept. of Zoology, KARAM SINGH.
College of Science,
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ALKALI STABLE GROWTH FACTORS IN LIVER HOMOGENATES

SEVERAL authors[1,2] have noted that liver homogenates contain some alkali stable bacterial growth factors besides the vitamin B_{12} group. The alkali labile factor was reported to belong to the vitamin B_{12} group, while the alkali stable factors were not fully characterised, though their desoxyriboside nature was suggested earlier.[1,2] In this note evidence has been presented to show that two such alkali stable factors are hypoxanthine desoxyriboside and thymine desoxyriboside.

Ox liver was hydrolysed with papain by a modified method of Davis *et al.*[3] The growth factors were assayed microbiologically by the agar-cup method. The nitrogen content of the different fractions was analysed by a modified micro-kjeldahl method, and microanalysis of phosphorus was done according to Jones *et al.*,[1] while the spectrophotometric studies were carried out with Beckman ultraviolet spectrophotometer.

Whole liver hydrolysate was heated to 100° C. at pH 7·0 for about 30 minutes, and then cooled and dialysed against distilled water asceptically. The undialysed fraction contained no growth factor. The dialysate was then passed through a column of the hydrogen form of Zeo-Karb — 215, when all amino acids, lower peptides and degradation products, vitamin B_{12} group and other basic components were adsorbed completely, leaving the alkali stable growth factors with some polysaccharides in the effluent. The effluent containing the alkali stable growth factors was then treated with Darco-KB, filtered, and concentrated at low temperature under reduced pressure. It was

then analysed by paper partition chromatography, using a mixture of *n*-butanol (4 parts), ethylene glycol monomethyl ether (1 part), and 0·5 N aq. HCl (2 parts) as the solvent. Three alkali stable growth factors with R_f (*a*) 0·43, (*b*) 0·73, and (*c*) 0·78 were detected on the chromatogram, and were eluted with water. The ultraviolet absorption maximum ($\epsilon_{max.}$) of these three fractions were at 254 mμ, 260 mμ and 265 mμ respectively. Both the fractions (*a*) and (*c*) contained desoxyribose, as confirmed by diphenylamine reaction (Dische, $\epsilon_{max.}$ at 600 mμ). None of the fractions contained phosphorus, while fraction (*b*) has not yet been fully investigated. Aliquots of fractions (*a*) and (*c*) were dried and the residues hydrolysed with formic acid (98/100%) at 175° C. for 60 minutes and then rechromatographed, and the spots detected and eluted with water. The eluate from (*a*) was identified with pure hypoxanthine (National Biochemical Corporation, Ohio), having similar R_f values, UV-absorption curves and similar (γN/ml.)/ ϵ_{max} ratios. Similarly the eluate from (*c*) was identified with thymine. Further, thymine desoxyriboside which was prepared from purified herring roe desoxyribose nucleic acid according to Waldhof[5] was identified on the chromatogram with fraction (*c*).

The author wishes to express his thanks to Mr. S. Ghosh for technical help and to Drs. U. P. Basu and A. N. Bose for their interest in this investigation.

Bengal Immunity Res. Inst., S. K. DUTTA.
Calcutta-16, *November* 1954.

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SOME ABNORMAL FEATURES IN THE VENOUS SYSTEM OF THE GARDEN LIZARD, *CALOTES VERSICOLOR*

DURING the course of study of the internal anatomy of the garden lizard the following abnormal features were observed in the venous system of one specimen (Fig. 1).

The caudal vein, instead of bifurcating at the base of the tail into two pelvic veins, runs across the ventral surface of the right kidney very close to its inner margin; and before leaving the latter it gives a branch to the left kidney. The left fermoral and sciatic join together and enter the left kidney. The right pelvic, after being joined by the right femoral and sciatic, proceeds forwards through the body-wall up to the forelimb and there bends inwards and enters the right precaval. The left pelvic vein and the abnormal vein are thus absent in this specimen.

The right and left renal veins are equally developed and enter the liver lobes separately, the postcaval being absent below the liver. A single postcaval however emerges out anteriorly from the liver and enters the heart.

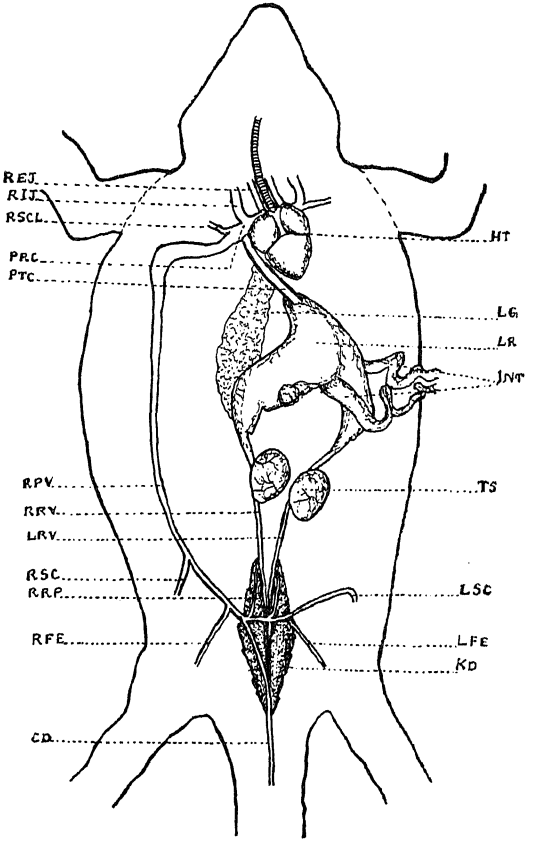


FIG. 1. CD–caudal vein. HT–heart. INT–intestine. KD–kidney. LFE–left femoral vein. LG–lungs. LR–liver. LRV–left renal vein. LSC–left sciatic vein. PRC–precaval vein. PTC–post-caval vein. REJ-right external jugular vein. RFE–right femoral vein. RIJ–right internal jugular vein. RPV–right pelvic vein. RRP–right renal portal vein. RRV–right renal vein. RSC–right sciatic vein. RSCL–right subclavian vein. TS–testis.

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Govt. Arts College,
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January 3, 1955.

ESTIMATION OF ORGANIC COMPOUNDS WITH THE PLATINUM-TUNGSTEN BIMETALLIC ELECTRODE SYSTEM

THE Pt-W bimetallic electrode system[1] has been successful in electrometric inorganic oxidation-reduction titrations. The present communication reports on the applicability of the system for the determination of equivalence in the estimation, by the bromination method,[2,3] of readily and stoichiometrically brominated organic compounds, *e.g.*, aromatic amines, etc.

Weighed amounts of A.R. grade organic compounds were dissolved in suitable solvents. An aliquot, acidified with sulphuric acid to a 2N solution, was taken in a Pyrex cell fitted with platinum and tungsten electrodes. The electrical circuit was similar to that used by Gay,[1,4] and consisted of a 1·5 volt cell with its negative pole connected to the tungsten electrode, a 1 kΩ fixed resistance, a 200Ω variable rheostat and a suitably shunted galvanometer, all in series. Galvanometer deflexions were noted after successive additions, from a burette, of small amounts of a standard 'bromine mixture' ($KBrO_3$ + KBr) and thorough mixing. Observations were continued, in each case, beyond the anticipated point of equivalence.

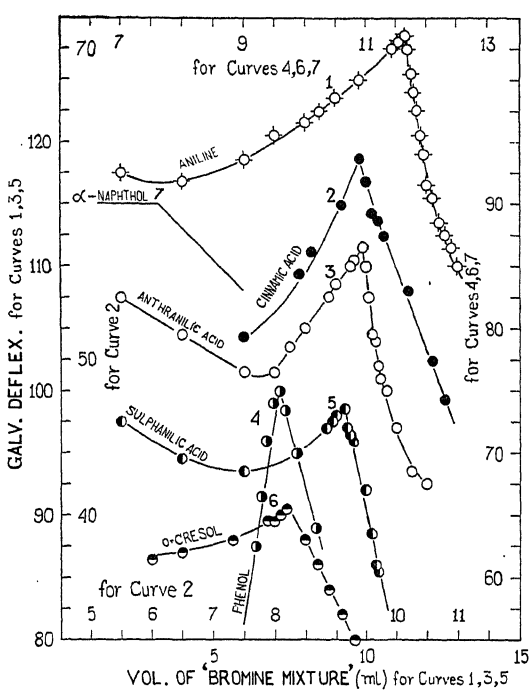


FIG. 1. Pt-W Electrode System for the Determination of Equivalence in the Estimation of Organic Compounds by the Bromination Method.

Representative results are shown graphically in Fig. 1. It will be seen that the breaks, which correspond to points of equivalence, are markedly defined. The amounts of the organic compounds taken and those calculated are shown in Table I.

TABLE I

Substance	Solvent	Weight (g.)		
		Present	Found	Error
Aniline	Dil. H_2SO_4	0·8860	0·8863	+0·0003
Anthranilic acid	do	0·3387	0·3386	−0·0001
Sulphanilic acid	do	0·2670	0·2677	+0·0007
Phenol	Water	0·1528	0·1530	+0·0002
o-Cresol	do	0·2626	0·2616	−0·0010
α-Naphthol	Acetic acid	0·0481	0·04822	+0·00012
Cinnamic acid	Alcohol	0·6952	0·6947	−0·0005

It is evident from an examination of data in Table I that the error is generally far less than that usually met with in ordinary estimations; this is indicative of the fact that the Pt-W electrode system is applicable for the quantitative determination of organic compounds by the bromination method.

Grateful thanks of the authors are due to Prof. S. S. Joshi for his kind interest in the work.

Electro-Chem. Lab.,
Banaras Hindu University,
January 9, 1955.

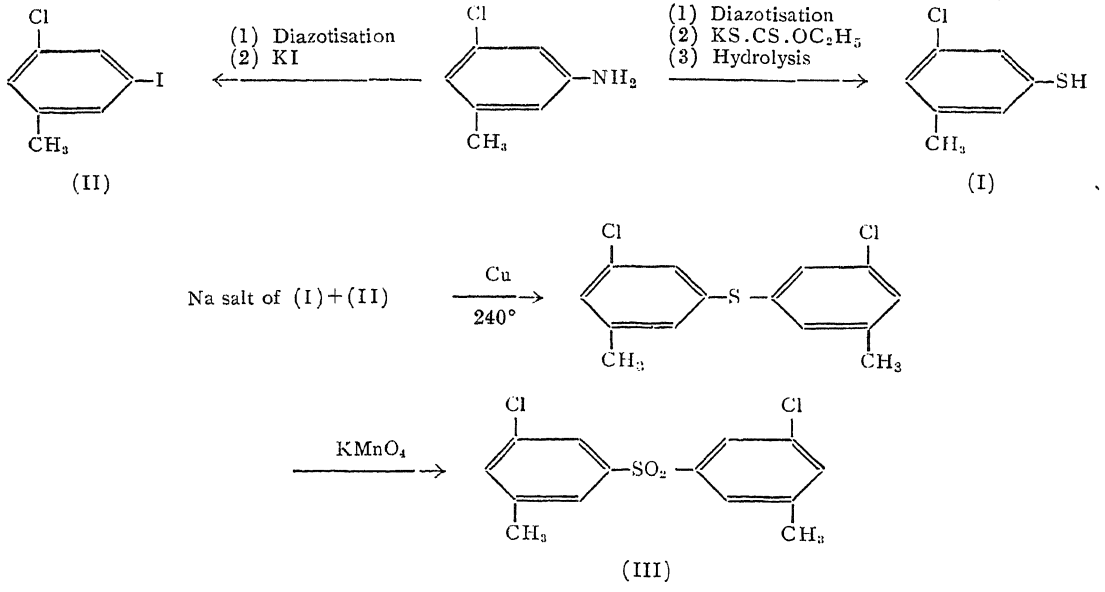
D. SINGH.
J. GOPALA KRISHNA MURTY.
S. R. MOHANTY.

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SYNTHESIS OF BIS-(3-CHLORO-5-METHYLPHENYL) SULPHONE

RECENTLY we prepared some bisamisoaryl sulphones having possible antituberculous and antileprous activity. While elucidating their structure we had occasion to synthesise bis-(3-chloro-5-methylphenyl) sulphone (III). The important steps involved in its synthesis are shown in the chart and the relevant experimental details are herein reported.

3-Chloro-5-mercaptotoluene.—9 g. of 3-amino-5-chlorotoluene[1] was diazotised using 40 c.c. of hydrochloric acid (1 : 1) and 6 g. of sodium nitrite. The diazonium salt solution was added



dropwise with continuous stirring to a solution of potassium ethyl xanthate (12 g. in 15 c.c. of water) kept at 40-45°. After the addition was over, the mixture was kept at the same temperature for one more hour and the resulting red oil was extracted with ether and dried over calcium chloride. After removing the ether, the oil was dissolved in ethanol (60 c.c.), brought to reflux on a water-bath, potassium hydroxide pellets (20 g.) were gradually added and heated for 8 hours. At the end, about 50 c.c. of ethanol was removed by distillation and the residue was dissolved in the minimum amount of water. The solution was acidified with sulphuric acid (1 : 1), mixed with zinc dust (5 g.) and steam-distilled. The thiophenol which distilled over, after extraction with ether and drying over anhydrous magnesium sulphate, weighed 5·7 g. (57%). It boiled at 94-95°/8 mm.; n_D^{27} 1·5875 (Found: C, 52·8; H, 4·6. C_7H_7ClS requires C, 53·0; H, 4·4%).

Its *benzoyl derivative*, on recrystallisation from methanol, melted at 77·5-78·5° (Found: C, 64·4; H, 4·5. $C_{14}H_{11}OClS$ requires C, 64·0; H, 4·2%).

Bis-(3-chloro-5-methylphenyl) Sulphide.—Sodium (0·6 g.) was dissolved in absolute ethanol (15 c.c.) and the solution was mixed with 3-chloro-5-mercaptotoluene (3·8 g.). After removing the ethanol by distillation, the residue was mixed with 3-chloro-5-iodotoluene[2] (6 g.) and copper powder (0·2 g.), heated in an oil-bath at 240-45° for 3·5 hours and cooled. Ethanol (20 c.c.), sulphuric acid (1 : 1; 10 c.c.) and zinc dust (1 g.) were added and the mixture was steam-distilled. The residue, after extraction with ether and drying ($CaCl_2$), yielded 4 g. (59%) of the sulphide, m.p. 34-35° (from ethanol) (Found: C, 59·4; H, 4·1. $C_{14}H_{12}Cl_2S$ requires C, 59·4; H, 4·2%).

Bis-(3-chloro-5-methylphenyl) Sulphone.—The foregoing sulphide was oxidised in glacial acetic acid with potassium permanganate (5% solution). The yield was 97%. Recrystallisation from ethanol gave shining plates, m.p. 163·5-164·5° (Found: C, 53·4; H, 3·9. $C_{14}H_{12}O_2Cl_2S$ requires C, 53·3; H, 3·8%).

Dept. of Chemistry, M. BALASUBRAMANIAN.
Annamalai University, V. BALIAH.
Annamalainagar,
November 3, 1954.

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REVIEWS

Engineering Metallurgy. By E. M. H. Lips. (Phillips' Technical Library), 1954. Pp. xv + 250. Price not given.

The author of this hand-book is Head of the Metallurgical Laboratories of Phillips Lamp Works at Eindhoven where his duties bring him into daily touch with a variety of design problems in many branches of engineering. He is thus in a position to know where the advice of the metallurgist is most needed by the engineer. In preparing this book he has clearly profited to the full from his experience. Metals are of course amongst the main materials of construction used by the engineer and many attempts have been made to present the engineer what he needs to know about metals. The present book is a conspicuously successful attempt in this direction in spite of a few minor flaws. The judgment shown in selecting the field to be covered is particularly commended. Dr. Lips has recognised that the engineer wants to know what to expect of his metals and how to prepare them by heat-treatment or otherwise to ensure that he will get the maximum service from them. He requires a basis for selection and design using metals and alloys some of which have been traditional materials of construction for many years but some of which are new-comers into the field. This information is given concisely in this book. The subject-matter is treated in several chapters which deal with mechanical properties of metals and alloys; corrosion of metals and alloys; phase diagrams and their significance for metals and alloys; alloys of iron with carbon and other metals; non-ferrous metals and alloys; heat treatment of metals; and the working and joining of metals.

No book is perfect and the author of this one occassionally errs. He does not seem to be quite sound in his remarks on the meaning of the stress/strain diagram of the metals especially in relation to tensile strength. It is surprising that under the chapter on Non-Ferrous Metals and Alloys, no information is given on nickel, cobalt and their alloys. This is rather surprising in view of the emphasis which is placed on certain aspects of high temperature materials. In the chapter on 'The Working and Joining of Metals' inadequate attention seems to have been given to welding.

The book is a translation and the author has been very well served by his translator. The compositors have not done quite so well, a number of misplaced letters marring what is otherwise a finely designed and printed book which will add to the excellent reputation already enjoyed by Phillips' Technical Library. As pointed out in the preface, the book is of special value to students preparing for such examinations as Higher National Certificate Courses in Production Engineering. Its value is however not limited to students: it will certainly be enlightening and helpful to many qualified engineers and metallurgists.

E. H. BUCKNALL.

Luminescence (with Particular Reference to Solid Inorganic Phosphors). (*British Journal of Applied Physics, Supplement No. 4.*) (The Institute of Physics, London), 1955. Pp. 111. Price 25 sh.

The papers published in this supplement, with the discussion on them, comprise the proceedings of the Conference held in Cambridge on 7-10, April 1954. The Conference was organized by the Committee of the Electronics Group of the Institute of Physics and was the first major discussion on the subject of luminescence since a Conference held in Oxford in 1938; the emphasis was upon solid inorganic phosphors. Twenty-one papers were presented excluding the two introductory papers. The subject-matter of the papers may be summarised as follows:—

As a result of rapid developments in luminescence during war-time and after, a large number of new phosphors have been discovered with the use of large proportions of structure modifiers like fluorine and titanium, and alkali metals like lithium and sodium. Among the new phosphors special importance is attached to calcium halophosphates activated singly by antimony or doubly by antimony and manganese, tin-activated pyro- and tetraphosphates of strontium and barium; and a group of manganese and cerium manganese activated silicates containing lithium and some phosphors excited by ultra-violet radiation of short wave-length, namely, boron phosphate activated by thallium and some arsenate analogues of the halophosphates and self-activated

vanadates excited by ultra-violet radiation of long wave-length. The preparation as well as the important characteristics of these phosphors have been discussed. The mechanism of excitation of luminescent solids by an applied potential, or what is called electro-luminescence, has met with spectacular advances in the practical field, for example, in the construction of electro-luminescent lamps. Several characteristics of the electro-luminescent phosphors have been studied extensively like their brightness, waveforms and the correlation between dielectric properties, rectifier action and photo-conductivity, etc.

Another important advance is the development of sensitised luminescence. Here the luminescent phosphors contain an activator proper, which is responsible for the main emission band and which has no absorption band in the spectral range desired for excitation and consequently shows no fluorescence under radiation by light of that wave-length, and a sensitizer which serves to introduce an absorption band at the desired location. The processes of energy-transfer from the sensitizer to the activator has also received considerable attention.

The present theories about luminescence are not very satisfactory. Two models have been mainly assumed for an explanation of the observed phenomena, one, the configuration co-ordinate model and the other, the energy band diagram; but both appear to be rather crude, considering the basic assumptions regarding electron transitions, positive hold migration trapping and retrapping, etc. A new theory has been proposed about the luminescent centre in which the compensation of charge by lattice vacancies or by activator ions is localised in the vicinity of the activator ions. A general theory has also been proposed to correlate the conductivity and luminescence measurements with the energy states of a crystal lattice perturbed by impurities or defects and to the electronic transition probabilities between these various states.

The importance of X-ray analysis of phosphors and some other physical measurements and also of the controlled method of preparation are outlined. Radioactive tracers are of very great importance in controlling the efficiency of purification of the raw materials, and they are finding more and more use in the preparation and study of the luminescent solids. In the case of photo-conducting phosphors, the luminescence and photo-conductivity are complicated in non-linear functions of the exciting intensity. An account is given of the types of non-linear behaviour and the generality of their occurrence with different models.

The book will be useful not only to persons working on solid state physics but also to physicists in general. R. S. K.

Ion Transport Across Membranes. Edited by Hans T. Clarke. (Academic Press), 1954. Pp. xi + 298. Price $ 7.50.

This volume is a collection of fourteen papers contributed by various investigators to a symposium on the role of proteins in ion transport across membranes, sponsored by the National Science Foundation in 1953.

The diversity of biological membranes, the nature and mechanism of the ion transport through living cell membranes by active transport as distinct from simple diffusion (passive) are well discussed by Ussing. Huxley describes the electrical processes associated with conduction of nerve impulse, namely, the ionic movements and ionic concentration gradients generating bioelectric potentials and also clearly points out the gaps in the system, such as the molecular mechanism of the striking changes in permeability and the utilisation of metabolic energy to charge the ionic battery. The possible role played by acetylcholinesterase and ATP in this regard, and the existence of so-called receptor protein endowed with certain special properties as postulated by Nachmansohn have been further substantiated by spectrophotometric and light scattering studies. The ion permeability of the red cell to cations and anions and the mechanism of specific ion accumulation are discussed in the fifth paper. The mechanism of electrolyte transport in the kidney (as distinct from nerve, muscle and red cell) for regulating excretion involving filtration, reabsorption, secretion and ion exchange have been dealt with by Mudge.

A general theory has been outlined and model equations worked out by Eyring *et al.* to treat the known facts about the permeability and electrical potentials developed. The membrane potentials are shown to depend on temperature, pressure, composition and, in particular, on the thermodynamic state of the membrane component. The ion exchanger membranes are shown to be very useful as electrodes at which there is no oxidation or reduction and no restriction to special classes of ions except as to size, and may serve as useful models for physiological membranes. The fundamental electrochemistry of model membranes of porous character is exhaustively dealt with by Souner *et al.*

Two very important equilibrium problems, *viz.*, the Donnan membrane equilibrium and the binding of ions or molecules by protein molecules in solution are discussed by Hill, using the very elegant method of McMillan and Mayer. The intensive researches conducted by Edsall *et al.* on a highly specific and remarkable dimerization reaction occurring by the interaction of serum mercaptalbumin with mercury and organic mercurials, throwing further light on the detailed pattern of molecular structure of these particular proteins are reported in the twelfth paper. The reversible type of metal protein reactions have been reviewed by Gurd indicating the alternative types of interactions: (*a*) binding of metal to individual groups in a protein molecule, (*b*) cross-linking in an intermolecular complex, and (*c*) cross-linking in an intramolecular complex. Some general conclusions have also been drawn regarding the solubility behaviour of metal-protein complexes. In the last paper, Debye presents certain additional quantitative aspects of the effect, showing that polymer solutions adjust the concentration distribution of the solute when subjected to influence of inhomogeneous electric fields.

This publication is authoritative and will be welcomed by all biologists, physical chemists and protein chemists.

Y. NAYUDAMMA.

High Polymers Celluose and Cellulose Derivatives, Vol. V, Part II. Edited by Emil Ott, Harold M. Spurlin and Mildred W. Graffiin. (Interscience Publishers, Inc.), 1954. Pp. xvi + 437. Price $ 11.50.

Part II of the book deals largely with problems connected with the industrial processing and utilisation of cellulose. The four chapters in this part deal with preparation of cellulose from its natural sources, bleaching and purification of wood cellulose, properties and treatment of pulp for paper, and derivatives of cellulose.

The chapter on preparation of cellulose from its natural sources has been rearranged and largely rewritten to include recent theoretical work on the theory of sulfite process and kraft process. The discussion on testing of the properties of pulp to predict its end use has also been extended. In the section on cotton linters have been added two useful flow sheets for linters purification process and for chemical cotton drying process. The section dealing with pulp-making from grasses and cereal straws is fundamentally unchanged. Chapter 8 dealing with the properties and treatment of pulp for paper is a new addition. This chapter deals with the various properties of the pulp, details of the beating process including a description of beating equipment and their action on the pulp, various theories of beating and its results. The chapter ends with a discussion of the chemical testing of pulp and its limitations in evaluation of pulps for paper-making.

Chapter 9 on the derivatives of cellulose has been largely rewritten. It starts with a discussion of theoretical and experimental methods of determining the distribution of substituents in cellulose derivatives which is an important technical problem. This is followed by a masterly treatment of the physical and chemical structure of cellulose and its effect on the rate and degree of substitution.

The section on inorganic esters in this chapter is essentially unchanged though brought up to date, while in the section on organic esters some interesting charts on the relation between composition and properties of cellulose triesters and mixed aliphatic esters have been added. The discussion on alkali derivatives includes a brief but clear account of technical mercerisation and the resulting changes in properties of the fibres. The section on cellulose esters has been considerably expanded and rewritten to include more details of preparation and properties of methyl and ethyl celluloses and brief notes on the more recent hydroxyalkyl celluloses, cyanoethyl celluloses and carboxymethyl celluloses. Similarly in the section on xanthates, the reaction mechanism of cellulose xanthate and viscose formation is discussed in greater detail. A new section has been added to this chapter. This deals with degradation of cellulose derivatives and gives an interesting discussion of the microbiological, hydrolytic and oxidative degradation of water-soluble and organo-soluble derivatives of cellulose. With the increasing industrial importance of cellulose derivatives this added information is certainly very useful.

P. C. MEHTA.

A Short Text-Book of Colloid Chemistry. By B. Jirgensons and M. E. Straumanis. (Pergoman Press, London), 1954. Pp. xvi + 420. Price 40 *sh.*

The book under review is a revised version of the authors' 'Kurzes Lehrbuch der Kolloidchemie' published by Bergmann and Springer in 1949. The book is divided into two parts.

In the first part comprising three chapters, the fundamental terms, classifications and elementary laboratory methods are outlined. Inorganic and organic colloids, globular and fibrous colloids, molecular and micellar colloids and solvation of colloids are very elegantly explained for a beginner. Simple experimental procedures like filtration and ultra-filtration, diffusion and dialysis, flocculation, viscosity, optical investigations, etc., are also described. The second part, which consists of sixteen chapters, contains an elaborate discussion of classical and modern techniques of light scattering, electrophoresis, ultracentrifugation, viscosity, electron microscopy, X-ray analysis, etc.

The kinetic properties of the disperse systems like the Brownian movement, etc., interfacial properties of colloids, optical properties like opalescence and reflection turbidity, light scattering, optical rotation and anisotropy and the electrical properties like electrophoresis, electro-osmosis and the charge of colloids and viscous properties of colloidal systems are lucidly explained in the book. Determinations of particle size and particle shape by the familiar techniques have been described. The electron microscope methods and x-ray methods with a number of interesting illustrations are given. The preparation of colloids by dispersion methods and condensation techniques are certainly a novel feature of this book. Coagulation, stability and protection of lyophobic colloids and solvation, flocculation, micellar aggregation, etc., of lyophilic colloids are some other interesting topics dealt with in this book. The concluding chapters deal with gels, jellies, membranes, emulsions, foams, aerosols and glass.

With its wealth of experimental details and theoretical explanations this book should prove suitable not only to Honours students in chemistry but also to research workers in various branches of natural sciences which include medicine, pharmacy, etc., in all of which knowledge about colloids is so very essential.

M. SANTHAPPA.

Tables of Error Function and Its Derivative. (National Bureau of Standards, Applied Mathematics Series 41.) (Order from Government Printing Office, Washington-25, D.C.). Pp. 302. Price $ 3.25.

The error function, or probability integral, in one form or another, has enjoyed a remarkably wide application in many diverse branches of science—from problems in refraction, the conduction of heat, and other fields of physics, to a variety of problems in the theory of probability and mathematical statistics.

Tables of the error function have been compiled before. The most extensive to date have been those due to Burgess, published in Scotland in 1898. Since then a variety of additional tables have been published. The present tables extend the range of all existing tables, and provide a smaller tabular interval and provision has been made to facilitate interpolation, both direct and inverse, by the user of the tables.

Tables of Functions and of Zeros of Functions. (National Bureau of Standards, Applied Mathematics Series 37.) (Order from the Government Printing Office, Washington-25, D.C.). Pp. 211. Price $ 2.25.

Prompted by a continuing demand for previously issued short tables of the National Bureau of Standards Computation Laboratory, NBS has decided to collect together groups of related short tables and issue them in convenient form. This volume is the first of certain projected numbers in the NBS Applied Mathematics Series to bear the subtitle, *Collected Short Tables of the National Bureau of Standards Computation Laboratory.*

The present volume presents ten tables of special functions, such as integrals of the Bessel functions J_0 and Y_0, exponential integrals, Struve functions, and values of $x^n/n!$, and eight tables of zeros of functions. The latter group includes zeros of the Legendre and Laguerre polynomials together with the weight factors needed for quadrature, as well as zeros of various kinds of Bessel functions. An introduction preceding each table gives a discussion of the theory underlying the table and details of method of computation, bibliographic background, and numerical illustrations. An introduction to the whole volume describes the scope of the various tables and incorporates, as a special feature, a reference to the principal review of each table.

Chemical Specificity in Biological Interactions, Vol. III. (*Harvard University Memoirs.*) Edited by Frank R. N. Gurd. (Academic Press), 1954. Pp. xv + 234. Price $ 6.0.

The series of seminars held in 1952 at Harvard University form the basis for the third volume of Harvard Memoirs, which maintains the high standard of the two previous volumes. The ten articles in this book cover a wide range of topics related to the study of chemical forces underlying biological interactions with special

reference to proteins. The first chapter by the late E. J. Cohn deals with the specific reactions of proteins with metals as the basis for a new technique of protein fractionation. The present methods for the isolation of individual proteins are chiefly empirical. Though the value of the new technique still remains to be established, a more detailed description of the technique and equipment in a subsequent volume of the series will be awaited with interest. In the second chapter the effects of radiation on proteins and living tissues are briefly outlined by Shields Warren.

The next two articles are on steroids, one by R. B. Turner on the configuration of steroids and their binding by proteins and the other by E. B. Gallagher on the biochemistry of steroid hormones. V. du Vigneaud's description of the purification and analysis of vasopressin and oxytocin will be of considerable interest in view of his subsequent determination of structure and synthesis of these polypeptide hormones. The application of ion-exchange chromatography to the isolation of *a* and *b* nucleotides and the structure of ribonucleic acid are outlined by Waldo E. Cohn, whose pioneering work has led to rapid advances in this field. The remaining four chapters of the book will be of special interest to the protein chemist. The formation and stability of metal complexes are ably discussed by C. D. Coryell and G. Schwarzenbach. The reactions of metals with small molecules in relation to metal-protein interactions are reviewed by J. Schubert, and the interaction of proteins with small molecules and ions are discussed by G. Scatchard *et al.* This brief summary will indicate that this volume should be of interest both to the biochemist and to the specialist in protein chemistry.

The typography and get-up of the book are of high standard. The "'chair and boat" structures of cyclo-hexane on page 34 are, however, wrongly numbered. It would be of value to amplify the incomplete legends for figures 3 and 4 in Chapter I. V. JAGANNATHAN.

Text-Book of Zoology, Vol. 1. By D. Mukherjee. (New Book Stall, Calcutta), 1954. Pp. x + 556. Price Rs. 25.

Prof. Mukherjee is a teacher of long experience in the Calcutta University and this book has been written with a view to meeting the needs of students preparing for the I.Sc. and B.Sc. Examinations, primarily in the Calcutta University but generally in all Indian Universities. The book is in three parts, apparently to be included in two volumes. The first volume, under review, includes two of them; the first part deals with the general principles of biology, like Structure and Composition of Protoplasm, Cytology, Genetics and Evolution, Embryology, Histology, Classification and Distribution of Animals. The second part deals with the structure and classification of the non-chordata. The second volume, to be published, will deal with the chordata.

This is a refreshingly new treatment. In the first 150 pages is dealt almost all the general principles underlying the existence and maintenance of living organisms on this earth, their chief characters and manifestations, their general structure, the manner in which they maintain themselves and occupy the present position in this planet. Useful chapters on the use and care of the microscope and laboratory methods are provided.

There are two accepted methods of teaching Zoology: the 'type method' and the 'comparative method'. Both have their advantages and drawbacks and with judicious treatment, both can bring home to the student the underlying idea of the great variety and richness of animate nature and emphasise the basic evolutionary concept that a study of biology should provide. No teaching of Zoology is successful except on the basis of the message of evolutionary thought and none useful which fails to bring home to the student the cardinal principle of organic evolution. Prof. Mukherjee adopts the type method, but he does not neglect the great diversity of animal organization and, in the opinion of the reviewer, very effectively brings to the mind of the reader, the illimitable fascination of the study of animal life. The descriptions are clear and the illustrations effective.

It seems doubtful, however, if the book will be in the hands of as many students as would desire to have it—the cost (Rs. 25) is rather high. But with the several-fold increase in book-printing and preparation costs during recent years, this seems to a certain extent unavoidable. We would recommend it to all students of biology in the universities as well as to such laymen that wish to acquaint themselves with the life and characteristics of animals. B. R. S.

Books Received

Abstract Bibliography of Cotton Breeding and Genetics, 1900-50. By R. L. Knight. (Commonwealth Bureau of Plant Breeding and Genetics, England), 1954. Pp. 256. Price 21 *sh.*

Liquid—Liquid Extraction. By L. Alders. (Elsevier Publishing Co.), 1955. Pp. x + 206. Price 32 *sh.*

Advances in Virus Research, Vol. II. Edited by K. M. Smith and M. A. Lauffer. (Academic Press), 1954. Pp. x + 313. Price $ 7.00.

Advances in Carbohydrate Chemistry, Vol. 9. Edited by L. Wolform. (Academic Press), 1954. Pp. xviii + 426. Price $ 10.50.

Chemistry and Chemical Technology of Cotton. Edited by Kyle Ward Jr. (Interscience Publishers, Inc.), 1955. Pp. xix + 782. Price $ 20.00.

Optical Glass Working. By F. Twyman. (Hilger & Watts Ltd.), 1955. Pp. viii + 275. Price 24 *sh.*

Frontier to Space. By Eric Burgess. (Chapman & Hall), 1955. Pp. xvi + 174. Price 21 sh.

Relativity for the Layman. By James A. Coleman. (William Frederick Press, New York), 1954. Pp. 131. Price $ 2.75.

A Symposium on Amino Acid Metabolism. Edited by W. D. McElroy and H. Bentley Glass. (Johns Hopkins Press, Baltimore), 1955. Pp. xvi + 1048. Price $ 12.50.

SCIENCE NOTES AND NEWS

First Congress on Theoretical and Applied Mechanics

The First Congress on Theoretical and Applied Mechanics will be held during November 1955 at the Indian Institute of Technology, Kharagpur. Exact dates will be announced later. It will be the first congress of the kind to be held in this country to bring together engineers, mathematicians, physicists and statisticians who are interested in applied mechanics. Dr. K. S. Krishnan, Director, National Physical Laboratory will preside over the Conference and Dr. S. R. Sen Gupta, Director, Indian Institute of Technology, will be the Chairman of the Reception Committee.

The Congress will be on a research level. Papers may be communicated and read on any of the following subjects: Elasticity—Plasticity—Rheology; Fluid Mechanics—(Aerodynamics—Hydrodynamics); Mechanics of Solids—(Ballistics—Vibrations—Friction—Lubrication); Statistical Mechanics—Thermodynamics—Heat Transfer; Mathematics of Physics and Mechanics—Methods of Computation. Further details can be had from Dr. B. R. Seth, Organizing Secretary, First Congress on Theoretical and Applied Mechanics, Indian Institute of Technology, Kharagpur.

Madras University Prizes

The Maharaja of Travancore-Curzon Prizes for 1955-56: Two prizes (one for Physiology and one for Geology) will be awarded by the Syndicate for the best essay or thesis written by any graduate of the Madras University on any topic dealing with the subjects. The value of each prize is Rs. 250. Competitors should submit their theses so as to be received by the Registrar not later than the 1st March 1956.

Sir William Wedderburn Prize, 1956: The prize which will consist of books of the value of Rs. 45, will be awarded to the student, who having qualified in Chemistry for the Degree of B.Sc. (Honours) or M.Sc. not more than two years previously, has shown aptitude for research. A thesis on any research work conducted by the student should be submitted with the application so as to be received by the Registrar, Madras University, not later than the 30th April 1956.

Journal of Family Welfare

A bimonthly Journal devoted to family welfare has been started under the editorship of Dr. A. P. Pillay, in Bombay. The appearance of the Journal is timely, and it caters to a very wide public as may be judged from the contents of the inaugural number: Marital maladjustments and marriage counselling, The Special Marriage Act of 1954, The so-called 'artificial' insemination, Differential fertility and its effect on community welfare, Family planning in India, Assessment of sperm density from dry smears of semen, An approach to the problem of infertility, Sterilization in the male. The first three numbers which have been received make it clear that it has a very useful part to play in educating the lay public in regard to the personal, marital and sociological aspects of family life, and we extend to the Journal our heartiest good wishes. Copies may be ordered from: The Editor, *Journal of Family Welfare,* 378, Hornby Road, Bombay-1.

Virology

Academic Press Inc., Publishers, announce a new Journal, *Virology*, with Dr. George K. Hirst, Public Health Research Institute of the City of New York, Inc., as the Editor-in-Chief. The purpose of *Virology* will be to publish articles on the biological, biochemical and biophysical aspects of the subject, stressing contributions of a fundamental rather than applied nature. It is hoped that the Journal will contribute to the integration of virus science by providing a ready introduction to all its fields.

It is planned to publish one volume per year. Volume 1, Number 1 is scheduled for release in May 1955. Subscriptions for the Volume 1, priced at $ 9.00, should be sent to the Publishers, Academic Press, Inc., 125 East 23 Street, New York 10, New York.

Inventory of Teaching Equipment for Medical Schools

A detailed inventory of the equipment needed to set up a medical school is now available as the result of a joint undertaking by the World Health Organization and UNESCO. This important reference manual is intended chiefly for use in new medical schools, but is also expected to be of help to existing medical schools which plan to re-organize their teaching departments on more modern lines.

This is Part V (Medical Sciences), Volume III of the UNESCO series "Inventories of Apparatus and Materials for Teaching Science" and contains lists of equipment used in the instruction of medical students in 8 subjects: (1) Anatomy, (2) Bacteriology (Microbiology), (3) Biochemistry, (4) Histology, (5) Morbid Anatomy (Pathology), (6) Pharmacology, (7) Physiology, and (8) Preventive and Social Medicine (Hygiene and Public Health).

The publication is priced at $ 2.75 and can be had from any of the national distributors of UNESCO Publications.

Aluminium in Australian Trees

The surprising discovery that certain trees in Australia and New Guinea accumulate aluminium has been reported by the Plant Industry Division of the Australian Commonwealth Scientific and Industrial Research Organisation. The Division examined about 80 species, and found that the aluminium exists in the form of compounds, hard white masses in the timber, also in the bark and the leaves, the trees apparently absorbing it from the soil.

When considerable quantities were found in a tree in Queensland, it was first considered a freak, but examination of other species, including coachwood, prickly ash, smooth-flowered nut trees, and Queensland blue beech, soon showed that various trees had accumulations.

It is not known whether the trees absorb the aluminium willynilly from the soil, or whether it plays some part in their growth. No trees in the dry inland area of Australia accumulate aluminium. It is in the rain forest areas that the research officers have found the compounds of the metal, together with organic acids.

World Health Day, 1955

"Clean Water Means Better Health" is the theme chosen for this year's World Health Day, 7 April, the seventh anniversary of the day on which the Constitution of the World Health Organization officially came into force. The series of feature articles issued by the WHO on the occasion have been written by authorities on various aspects of water supply, water protection or purification, and serve to emphasize the Organization's concern for the improvement of sanitation programmes, and to highlight a problem which is causing serious anxiety to health authorities in countries all over the world.

Radiocinematography

A documentary picture made by Dr. Pierre Thevenard of the Pasteur Institute in Paris, is the first successful example of "radiocinematography", or filming with X-rays. After previous attempts in the United Kingdom and Germany had failed, Dr. Thevenard decided to pursue the experiments and to produce a 35 mm. film on the biological history of the bluebottle (*Calliphora erythrocephala*).

Special camera equipment had to be assembled with strong magnifying power and a recording range of between 24 pictures a second and one picture every ten minutes. By means of irradiation through the aperture, and without either fluorescent screen or lenses, Dr. Thevenard was able to study the metamorphosis of the insect and the processes involved in the passage of food through its body. Unlike ordinary microphotography, X-ray filming retains the three dimensions.

Apart from its high artistic quality, the film emphasizes the exceptional value of radiocinematography as an instrument for scientific research. The various phases of the metamorphosis revealed by the X-rays provide evidence of hitherto unknown phenomena.—UNESCO.

The Institution of Telecommunication Engineers

The Institution of Telecommunication Engineers, inaugurated in New Delhi, India, in November 1953, has already more than a thousand members on its rolls and this figure is increasing rapidly. Its membership is drawn from various government operated communication agencies, the three Defence Services, Research Institutes and Industry. Run by a governing council of 24, the Institution, like most professional bodies, prescribes minimum educational qualifications and experience for entry into its several categories, but direct admission into the lower categories is also possible by passing the examinations which are to be conducted by it. A quarterly Journal of the Institution of Telecommunication Engineers is proposed to be published and the first issue of the Journal is already in the Press. Talks and discussion meetings are now arranged periodically at New Delhi, the Headquarters of the Institution, and similar activities are being planned at Bombay, Calcutta, Madras, Poona, Bangalore and Jabalpur. Further particulars of the Institution can be had from: The Honorary Secretary, The Institution of Telecommunication Engineers, Post Box 481, New Delhi, India.

Blood Fractionation

It has been estimated that the human body contains 5 litres of blood of which 2·75 litres is plasma, 2·22 litres is erythrocytes, 0·02 litre is platelets and 0·01 litre is leukocytes. A blood fractionator developed under the direction of the late E. J. Cohn at Harvard University provides a continuous closed mechanical system for fractionating the blood into its components from the moment it is drawn from the vein.

In this apparatus calcium is removed by passage through an ion-exchange resin which gives sodium and takes up calcium. Since glass and rubber are destructive, the component parts are built of non-wettable plastic coated with silicone. The blood is immediately cooled to near freezing within a few seconds after being drawn. It then passes through a centrifuge. On stopping the centrifuge the erythrocytes and leukocytes fall into their respective containers. The platelets are washed from the resin column and stored in a gelatin-containing medium. Platelets can be preserved for some months but as yet leukocytes cannot be. The plasma is fractionated into 26 identifiable substances by known laboratory methods (*J. Amer. Med. Assoc.*, **1954, 156,** 772).

Rapid Drying Coating Materials

A process for rapid hardening of inks, paints or other coating materials made from drying oils or reactive resins by means of sulphur dichloride has been developed by the Armour Research Foundation.

Sulphur dichloride vapour reacts with drying oils, resins made from drying oils (such as alkyl or epoxy esters), urea-formaldehyde melamine-formaldehyde, rubber and similar materials. In the case of drying oils and related materials containing a number of points of unsaturation, the sulphur reacts cross-linking the molecules in hardening. The resultant coating is different chemically from an air-dried film because it contains both sulphur and chlorine from the cross-linking agent. The weight of the coating is increased because of the absorbed sulphur dichloride. In the case of the urea and melamine resins, sulphur dichloride acts as an acid catalyst to initiate the polymerization. For reactive resins and oils, contact times of from 2 to 20 seconds will give either a complete hardening of the film in the case of thin coatings, or a sufficient surface dryness in the case of heavier applications.

Awards of Research Degree

The Muslim University, Aligarh, has awarded the Ph.D. Degree in Zoology to the following candidates for theses indicated against each: N. M. Antony—"*Avitellina centripunctata* Studies in Morphology and Life-Cycle"; S. Johnson—"Studies in Morphology and Life-Cycle of *Physaloptera varani*"; and S. Shujaat-ul Akbar—"Morphology and Life-History of *Leptocorisa varicornis*, a Serious Pest of Paddy Crop in India".

The Osmania University has awarded the Ph.D. Degree in Physics to Shri D. S. R. Murty for his thesis entitled 'Directional Studies in Cosmic Rays at Hyderabad, India', and to Shri V. V. Varadiah for his thesis entitled 'Viscosity and Light Scattering Studies on High Polymer Solutions'.

The Andhra University has awarded the D.Sc. Degree in Chemistry to Sri. A. Purushottam for his thesis entitled 'Studies on Rare Earths'.

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ALBERT EINSTEIN

FIFTY years ago, in the year 1905 to be exact, a series of papers appeared in the *Annalen Der Physik* within a few months of each other which profoundly influenced the subsequent development of physical science and indeed created a revolution in our conception of nature and its workings. The author of those epoch-making contributions to science was a young man then 26 years of age who held a position as an examiner of patents and designs in the Federal Patent Office at Berne, in Switzerland. It was not long before the immense importance of the ideas set out in those papers received general recognition and it became evident that a star of the first magnitude had arisen in the firmament of science.

The main facts of Einstein's life may be briefly summarised here. He was born on the 14th March 1879, at Ulm in South Germany but spent his childhood at Munich. In 1894, when his parents migrated to Milan in Italy, Einstein moved to Switzerland where he continued his further studies, firstly at Aurau and later at Zurich. Following graduation in 1900, he was obliged to seek employment for maintaining himself. In the autumn of 1902, he obtained a position at Berne in Switzerland in the Federal Patent Office where he remained till 1909. While thus employed, he also worked as a candidate for the doctor's degree which he obtained from Zurich in 1905. The recognition gained by his work led to his being called to a professorship at Zurich; for a short period he migrated to Prague and returned again at Zurich in 1912. Finally in 1914, Einstein moved to Berlin as Professor in the Prussian Academy of Sciences and Director of the Institute of Theoretical Physics. In the year 1933 as a consequence of the activities of the Hitler regime, he found himself obliged to resign these positions and accepted a call to a professorship at the Institute for Advanced Study at Princeton, New Jersey, in the United States of America. In the year 1945 he retired from

the latter position but continued to live at Princeton in quiet seclusion till his death on the 18th April of this year.

Einstein's record of scientific research and publication extends over half a century. The period from 1905 to 1915 however witnessed the emergence from his creative brain of those fundamental ideas which transformed the whole complexion of physical science. It is not possible to contemplate the results, at once so profound and so powerfully original, achieved by Einstein in this short period without a feeling of astonishment and admiration. We may permit ourselves to quote here the opening words of the admirable summary of Einstein's scientific work written by Louis de Broglie for the special volume dedicated to Einstein in the "Library of Living Philosophers" published in the year 1949. "For any educated man, whether or not a professional scientist, the name of Albert Einstein calls to mind the intellectual effort and genius which overturned the most traditional notions of physics and culminated in the establishment of the relativity of the notions of space and time, the inertia of energy, and an interpretation of gravitational forces which is in some sort purely geometrical. Therein lies a magnificent achievement comparable to the greatest that may be found in the history of the sciences; comparable, for example, to the achievements of Newton. This alone would have sufficed to assure its author imperishable fame. But, great as it was, this achievement must not cause us to forget that Albert Einstein also rendered decisive contributions to other important advances in contemporary physics. Even if we were to overlook his no less remarkable work on the Brownian movement, statistical thermodynamics, and equilibrium fluctuations, we could not fail to take note of the tremendous import of his research upon a developing quantum theory and, in particular, his conception of "light quanta" which, reintroducing the corpuscular notion into optics, was to send physicists in search of some kind of synthesis of Fresnel's wave theory of light and the corpuscular theory....."

Within the limits of this article it is not possible to attempt a general survey of the scientific work of Einstein or to review the influence exercised by it on his contemporaries and on the progress of physics which has been enormous. Many impressive tributes have been paid to the greatness of Einstein and his work by illustrious contemporaries. I need therefore add here only a brief acknowledgement of my own personal indebtedness to the inspiration that I have derived from time to time from a study of Einstein's fundamental papers on thermodynamics, light-scattering and quantum theory. I have returned to them again and again in the course of my work and benefited thereby.

C. V. RAMAN.

THE BUBBLE CHAMBER

THE 'bubble chamber', a new device that combines the experimental possibilities of the Wilson cloud chamber with the high mass density available in photographic emulsion techniques, was described at the recent meeting of the American Physical Society in New York. The feasibility of using the bubble formation in a liquid to make the path of ionizing particles visible was first demonstrated by D. A. Glaser of the University of Michigan, and the instrument was further developed by experimentalists at the University of Chicago and at the Radiation Laboratory in Berkeley. At present the device is being used in several laboratories to study high energy nuclear events.

The bubble chamber makes use of the unstable system of a superheated liquid—that is, liquid hydrogen at a temperature above its boiling point. As soon as ionizing radiation enters the system, gas bubbles are formed and the liquid starts to boil almost immediately. If, however, a picture of the bubble formation is taken a few microseconds after the ionizing event takes place, then the bubbles formed along the path of the ionizing radiation give rise to a visible track. The high density of the liquid, the almost complete absence of undesired tracks owing to the shortness of the time interval during which the chamber is sensitive to ionizing radiation, and the possibility of taking picture in rapid sequence make the bubble chamber an extremely versatile instrument for the study of high energy events.

AUSTRALIAN EXPERIMENTS IN RAIN-MAKING

IN the period from 1947 to 1951 about one hundred experiments of seeding of clouds with dry ice were made in Australia from aircraft. These experiments showed that given suitable cloud conditions it was tolerably certain that seeding with dry ice would produce rain which would not otherwise have fallen. The suitable cloud conditions are critically determined by the temperature in the top of the cloud. At temperatures of — 7° C. and colder there is 100% chance of producing rain. At temperatures between — 7° C. and 0° C., the chances of success taper off, tending to zero as 0° C. is approached. At temperatures of — 15° C. and lower the results lose significance because of the high probability of clouds producing rain naturally at these temperatures. The amount of rain produced by seeding increases with the thickness of the cloud, while the amount reaching the ground depends on the height of the base of the cloud in relation to its thickness. If the cloud is at least as thick as the height of its base, a considerable proportion of the rain will reach the ground.

In the experiments carried out the amount of dry ice used varied from 10-300 lb. on a single cloud, and the amount of precipitation appeared to increase with the greater quantity of dry ice used. The time for precipitation to appear was usually about 15-20 minutes, made up of about 10 minutes for the ice crystals to grow, and another 1 minute per 800′ of cloud depth for them to fall. Rain generally continued from 40-60 minutes, during which from 25-75 points were recorded. In assessing the success of the seeding experiments careful checks were made with radar for the presence of ice crystals that would produce rain naturally, and only clouds where these were absent were selected for seeding. A single cloud unit amongst a group of similar units was then chosen for seeding. If any of the other clouds produced rain during the experiment the results were disregarded, but if no rain fell other than from the seeded cloud the experiment was deemed successful.

Experiments in seeding clouds with silver iodide are similar in purpose and performance to those with dry ice. The quantity used is smaller, varying from a fraction of an ounce to several ounces per cloud. The silver iodide is either ejected from the aircraft with dry ice or dropped on a parachute flare. It is thought that colder cloud-top temperatures are necessary for success than with dry ice, and therefore there are less occasions on which silver iodide seeding will produce rain that would not have fallen naturally.

Another method of using silver iodide has been tried by releasing it in the form of smoke from burners on the ground to be carried upwards by convection. The only Australian experiment using this method was carried out near Hay, New South Wales, over a period of three months and was inconclusive. It appears that smoke particles of silver iodide lose their effectiveness before they reach the right part of the cloud. Yet some development of this method appears to offer possibilities as an economic means of large-scale rain-making.

Rain produced by coalescence of water droplets in clouds which do not reach to freezing heights occurs almost entirely in coastal and maritime areas. A good deal of the rain in Eastern Australia is due to this process. The necessary conditions for natural rain of this type are that the water content of the cloud should be relatively high, that there should be up-draughts of air of at least 1-2′ per second persisting for at least 30 minutes, and there must be a wide range of size of the water droplets, which is helped by the presence of hygroscopic nuclei. The up-draughts of air then lift the small drops faster than the large drops, which grow even larger by collision with smaller drops. If the first two conditions exist, but all the water droplets are of similar size, no rain will fall.

In these circumstances, seeding the base of the cloud with large water drops or some form of condensation nuclei will initiate the growth of water droplets at the expense of others to a size large enough to fall as rain. Experiments with aircraft flying about 1,000′ above the base of these types of clouds and spraying water at the rate of 100 lb. per mile have produced rain, but only from clouds over 5,000′ thick.

It is clear that these successful methods used in rain-making experiments are too expensive for use on a practical scale. The major cost is not in the materials, but in the use of aircraft. Fairly large and robust aircraft are necessary to reach heights well above freezing level, usually ranging upwards from about 8,000′, or to penetrate lower turbulent clouds. Actual flying time might not be too costly, but the necessity of having adequate aircraft standing ready to catch the right cloud formations at the right moment makes it an uneconomic proposition on a practical scale. The emphasis now lies on finding cheaper methods.

VIVOTOXINS AND FUSARIOSE WILTS IN PLANTS

C. V. SUBRAMANIAN

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DURING recent years considerable attention has been paid to the study of the mechanism of vascular wilt diseases of plants, especially those caused by Fusaria. One of the earliest to postulate a mechanism was Erwin Smith[1] who, in 1899, suggested plugging of the tracheæ in the stem of the infected plant by the hyphæ of the pathogen and the consequent impediment to the upward flow of solutes. Indeed, this is implied in the terms, "vascular wilts", "tracheomycoses", "hadromycoses", etc., which are in current use for these diseases, and they do convey a correct picture of the essential disease syndrome and the host-parasite relationship. Critical evidence to support the vessel-blocking hypothesis was, however, not presented by Smith or those who followed him and, with the publication, in 1913, of Hutchinson's[2] paper on a bacterial disease of tobacco in India the possible mechanism of which was explained as a case of toxin production, the new theory gained ground, and for well over forty years evidence claimed to be in support of Hutchinson's toxin theory of plant wilts accumulated in the hands of numerous workers. It is scarcely possible, in this brief note, to review all the investigations, but it would suffice to mention here that the method employed in most of these studies was to grow the pathogen in a standard synthetic medium (*e.g.*, Richard's) for varying periods of time and then test out the effect of the culture filtrates on cut shoots of different plant species. An improvement over this method sometimes used was the dialysis of the culture filtrate to remove from it inorganic ions which may themselves be toxic to test plants. Not infrequently, instead of the culture filtrates, the fungal mats themselves were ground up and the effect of extracts, aqueous or otherwise, of the macerated hyphæ on cut shoots was studied. Such studies suggested the possibility of the occurrence of (1) toxins excreted by the pathogens into the media in which they were grown (*exotoxins*), and (2) toxins produced within the hyphal cells of the pathogens themselves (*endotoxins*). The bulk of the data available are on exotoxins and opinions regarding the exact nature of these are varied. They have been stated to be enzymes, alkaloids, colloidal and crystalloidal substances, inorganic salts like nitrites, organic acids, amines, ammonia, polypeptides, etc. Endotoxins have received comparatively little attention and they have been suggested mostly to be of an enzymatic nature. Little thought has been given to the exact *modus operandi* of these endo-cellular enzymes of the pathogens. The evidence brought forward in most cases in support of the toxin theory of vascular diseases has been one where culture filtrates or extracts of fungal mats of the pathogenic Fusaria were tested for their effects on cut shoots and production of symptoms closely simulating those on plants naturally infected by the pathogens were followed and confirmed. In each case, sufficient precautions were taken, using suitable methods, to exclude the living cells of the pathogens from the filtrates as well as the hyphal extracts. In certain cases, complicity in wilt production was ascribed to certain definite substances and, as positive proof for the conclusion, the toxicity of these substances to cut shoots of plants was cited, although little evidence was presented to indicate that these substances are produced by the pathogens themselves. It would be unscientific to postulate any mechanism for wilt diseases on the basis of such observations since the same disease syndrome in plants may be brought about by a variety of causal agents and similarity of symptoms would be no indication of the nature of the causal agent. In studies on culture filtrates and extracts of fungal mats mentioned above, the *in vivo* physiological changes initiated in the host (cut shoot) tissues were explained on the basis of a poisoning of the living tissues leading to death, an injury to the semipermeability of the plasma membrane and the consequent impairment of the osmotic prerequisites for turgor, or an increased transpiration rate in the diseased state. For the disease syndrome which is a sequence of this process, the term "toxigenic wilting" has been suggested which is, therefore, indicative of the mechanism involved as postulated by these workers.[3]

There are, however, those who believe in Erwin Smith's hypothesis of vessel-blocking. There has been a search for a something that would explain fully the blocking effect, apart from the often scanty hyphal ramifications in the vascular system of infected plants originally mentioned to support the theory. This is now claimed to be either some homogeneous hyaline material in the vessels of infected

plants,[4] or polysaccharides produced by the pathogen,[5] or conjugated phenols arising from hydrolysis of β-glucosidases in the host,[6] or again products resulting from the maceration of cells in the xylem due to the action of exocellular pectic enzymes like pectin methylesterase.[7]

It is difficult, in the present state of our knowledge, to subscribe categorically to one or the other of these views. On the other hand, the evidence in favour of these hypothses could be critically discussed. *In vitro* studies using culture filtrates of the Fusaria and their effects on cut shoots are of limited value, since it is more than probable that what happens under *in vivo* conditions in a living and complex host-parasite relationship would not be the same as what would take place in a cut shoot-toxin combination. We have to consider here the *in vivo* changes following infection of a living plant with its own root system by a root-infecting pathogen. The question is not a simple one of the pathogen being present in the soil and producing toxic metabolites from suitable organic and inorganic substrates present in the soil and the movement of these metabolites into the host plants. Whilst the possibility of production of antibiotics and toxins in soils by pathogenic fungi cannot be denied, their rôle in plant disease production remains to be established, and the indications are that root systems of living plants may not selectively absorb fungal metabolites of high molecular weights, even though they may be produced in sufficient quantity in infested soils. To what extent toxic fungal metabolites produced in soils could act directly on the effective absorptive surface of the living root systems and damage them, or again, whether root membranes would be without effect in toxin-induced wilting, is not clear. However, if this happens, it should not then be difficult for any saprophytic micro-organism to gain entry into the host and elaborate its own toxins within the host tissues. Such a sequence of events is highly improbable since it would do away entirely with the vital process of absorption by the root systems of plants so affected on the one hand, and the phenomenon of pathogenesis on the other. Fuller knowledge of the rate of penetration of many of these fungal metabolites into living cells is obviously essential for a proper understanding of the physiology of these wilts. Much more remains to be known about their solubilities in the cell membranes of the host roots, their capacity for chemical reaction with the membranes, their adsorption by colloidal components of the membranes, the electrical charge on the membranes (as to kind and intensity), the kind and magnitude of electrical charges on the ions or molecules of the fungal metabolites themselves, the electrical potential across the membrane, the structure of the entering particle with particular reference to the presence of polar and non-polar groups, the size of the entering particle, the condition of the membranes as to the degree of hydration and the presence of other ions both outside and inside the absorbing cell of the host root system. The question of toxic metabolites produced in soils interfering with root respiration and retarding ion accumulation by the host plants should also be considered. It would appear that at present there is little evidence to indicate any visible damage to root systems in the case of the typical vascular wilts caused by Fusaria and the possibility of direct host invasion and damage by toxic metabolites produced in soils may be considered remote. On the other hand, there is some evidence to indicate that pathogenic Fusaria would produce substances stimulating rooting in cut shoots of plants[8–10] and, may be, in the case of rooted plants the same stimulating effect may come into play. Pathogenesis, then, becomes the essential prerequisite of disease and it follows that an intensive study of the host-parasite relationship is obviously important in understanding the mechanism of the vascular Fusariose wilts.

Much of the work on the *in vitro* toxic metabolites of pathogenic Fusaria has been carried out, as mentioned already, on cut shoots of plants, and Young and Bennett[11] were perhaps the earliest to state that these toxins were non-specific in their action on different host plants. Working with *Fusarium oxysporum* isolated from potato plants, they showed that the culture filtrate of this pathogen was equally toxic not only to potato, but also to tomato and celery. This non-specificity of toxic metabolites to cut shoots of plants has since been confirmed by numerous workers in the case of many species of Fusaria and a diversity of host plants. Another important finding is the fact that such toxic metabolites would be produced not only by pathogenic Fusaria, but also by non-pathogenic strains of Fusaria, and even by innocuous saprophytic moulds such as *Penicillium expansum* and *Aspergillus niger*. This again has received confirmation from many workers. It would appear, therefore, that almost any fungus may produce in culture

metabolites which would be toxic and non-specific to cut shoots of plants. A further criticism is that results obtained from pathogenicity trials and toxigenicity tests do not run parallel. For instance, culture filtrates of non-pathogenic strains may be very toxic but conversely filtrates of pathogenic strains may be only weakly toxic or not at all. Moreover, results obtained with cut shoots would have to be viewed with caution since they cannot reliably be applied to the case of rooted plants. In one case there would be a passive non-selective movement of the metabolite, whereas in the other one would expect a selective and regulated uptake of the metabolite. That this is, indeed, the case is shown by the recent work of Winstead and Walker[12] on several Fusaria with special reference to their pathogenicity on different hosts and the toxigenicity of their culture filtrates and hyphal extracts to the various host plants grown on sand culture. The experimental findings of Winstead and Walker indicate that toxigenicity tests when applied to rooted plants give the same results as pathogenicity tests. Thus, positive toxigenicity and pathogenicity in the case of *Fusarium oxysporum* f. *conglutinans* was recorded only on its own host, *i.e.*, a susceptible variety of cabbage, but not on several other hosts and resistant varieties of cabbage studied. Similar results were obtained with other Fusaria. It would, therefore, be futile to hope that the real answer to the question of the mechanism of these wilts would come from detailed studies on the culture filtrates of these Fusaria grown on synthetic media and their effects on cut shoots. On the other hand, in all experimental work rooted plants should be used and intensive studies should be made on the lines of the excellent work of Gottlieb[13] who has shown that a toxic metabolite could be detected in the tracheal sap of rooted tomato plants infected by *F. bulbigenum* v. *lycopersici*. There is thus evidence for the production of toxins *in vivo* within plants infected by Fusaria and such substances produced *in vivo* within the host tissues would well fit Dimond and Waggoner's[14] definition of *vivotoxins*.

Granting, then, that vivotoxins could be produced by vascular fungal pathogens within the host tissues, it remains to be considered how they would affect the host. Our knowledge of this aspect is again limited and can be summarised by stating that fungal metabolites produced *in vivo* within the host may contribute not only to impede the upward flow of water and solutes through the tracheæ, but may also impair the osmotic prerequisites essential for turgor and may initiate several other physiological changes within the host. For instance, alteration of the permeability of the host cells by toxic metabolites has been envisaged by some workers. Several chemical mechanisms have been postulated: of these, may be mentioned vascular discoloration and occlusion as a product of enzymic action by the pathogens; vivotoxins behaving as competitive inhibitors as, for instance, in the case of the wildfire toxin where competitive inhibition of methionine utilization has been established; and inactivation of enzymes in a non-competitive manner as shown by the results obtained with lycomarasmin which acts as an antimetabolite for the growth factor strepogenin.[14]

It must be emphasised, however, that a variety of metabolic products are usually produced by Fusaria under *in vitro* conditions, and these include, besides the toxic metabolites discussed already, even growth factors.[8-10] These growth factors have been shown in this Department to have thiamine replacement value and would even stimulate rooting of cut shoots of plants. Just as is the case with the toxic metabolites, these growth factors are produced, with a few exceptions, by several pathogenic and non-pathogenic strains of Fusaria so far tested[10] and even by fungi belonging to other genera.[15] They are, moreover, non-specific in their effects on cut shoots of different plants. It would appear, however, that the ability to produce such growth factors is not as common amongst the fungi as their ability to produce toxic metabolites, since they do not appear to be produced by fungi like *Aspergillus niger*.[15] Nevertheless, in view of the fact that such growth factors are fairly commonly produced *in vitro* by several vascular wilt Fusaria, it would be worthwhile studying, by suitable bio-assay techniques, their production *in vivo* in infected plants. There is no doubt that a clear understanding of the mechanism of these wilts and hence the basis for resistance or susceptibility *vis-a-vis* Fusariose wilts, in general, can follow only a consideration of the metabolism of the host/parasite in all its aspects, especially the *in vivo* toxic and growth factor components of the fungal metabolites. In the case of several Fusaria, infection of certain varieties is known but the disease syndrome characteristic of tracheomycotic wilting does not appear, the hosts acting as

"symptomless carriers".[16] It would, therefore, appear that in these peculiar instances conditions within the host are not conducive to the generalised spread of the pathogen within the host tissues and to the production of vivotoxins. It should, however, be admitted that one or more factors may be involved in the mechanism of disease resistance, *e.g.*, a host mechanism which may antidote the toxin if produced or one where the substrate relationships are such as to retard or inhibit production of vivotoxins, or else one which allows production *in vivo* of one or more growth factors far in excess of the amount of the toxic metabolites freed into the system. If one could state why a certain variety of a host should be susceptible and another resistant, from detailed studies on host physiology and the host-parasite relationship, it would then afford an explanation for the mechanism leading to the disease syndrome as we see it. It would be unwise to expect the same mechanism in the case of all Fusarioses, since the final disease syndrome in every case is equally dependent on the innate nature of the pathogen and the innate nature of the host. For this simple reason, a wide range of strains of the pathogens and also of the host plants should be included in studies on this difficult problem, before any general conclusions can be made. From what has been stated, the difficulties in experimentation and the gaps in our knowledge that have to be filled would be obvious. It is to be hoped that future work would clarify the many points raised here.

This brief resume is the result of stimulating discussions I have had with Professor T. S. Sadasivan from time to time, and I am deeply indebted to him for the same.

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CESIUM ATOMIC FREQUENCY STANDARD

THE development of an atomic "clock", the Cesium Atomic Frequency Standard, has been announced by Jerrold R. Zacharias, Director of the Laboratory for Nuclear Science at Massachusetts Institute of Technology.

Time-keeping in the device is controlled by the oscillation of electrons in the cesium atom. As an electron revolves around the nucleus of an atom, it "wobbles" very slightly but at a constant rate. This unvarying rate of oscillation is reflected in the frequency of waves that are emitted.

Cesium has a frequency of approximately 9192·632 Mc./sec., and it is this frequency that serves as the unit of time in the clock. A metal crucible encloses 0·01 g. of cesium. When heated to a temperature of about 100° C. the cesium shoots a stream of atoms through a hole in the crucible. The atoms strike a detector screen, and their frequency is reported through a complex apparatus. The cesium emits atoms at a rate of about 1 million per second, but the loss is only about 1 μg./day and, for all practical purposes, the clock is perpetual.

Standard time, with 1 sec. equal to 1/86,400 of the mean solar day and generally measured by the frequency of the oscillations of a crystal, is accurate to 10^{-3} sec. The Atomic Frequency Standard is accurate to 10^{-4} sec. Zacharias expects, through further development, to obtain accuracy of 10^{-6} sec. The Cesium Atomic Frequency Standard is similar to the "maser", (microwave amplification by stimulated emission of radiation) developed recently at Columbia University but operates on a different principle.

ORBITOIDES FAUJASI—THE FIRST ORBITOID FROM THE CRETACEOUS ROCKS OF SOUTH INDIA

L. RAMA RAO

THE occurrence of Orbitoidal foraminifera in the Cretaceous rocks of South India was recorded for the first time by Stoliczka[7] in 1873 during the study of the fossils from the Cretaceous rocks of the Trichinopoly District collected by Blanford[1] about ten years before, in the course of his geological survey of the area. Stoliczka noticed the Orbitoids in some of the rocks belonging to the Ariyalur group (of Blanford), and mentioned that his material includes "a single well defined species *Orbitoides faujasi* (Defr.) and two doubtful ones". This first record by Stoliczka is naturally of great importance as the starting point for all subsequent studies of South Indian Cretaceous Orbitoids; and it is therefore very necessary that we should have a clear idea of the nature of these Orbitoids and the exact age of their containing beds. Unfortunately much of the original material on which Stoliczka based his observations has been lost; in fact, even Vredenburg[6] who wanted to re-examine them in 1908 in connection with his work on the Cretaceous Orbitoides of India, had to be content with only a few "available remnants". So the only information that we have of the first orbitoidal collection is the description given by Stoliczka of the one species he identified in it, *viz.*, *O. faujasi* (Defr.). Even here it would appear that what Stoliczka has given is not the description of an individual type; it seems to be a generalised account of a group of shells on the assumption that all of them belonged to that one species. Regarding the other two "doubtful species" mentioned by him, we know nothing further. It is however important to note that his collection also did include species of orbitoidal shells other than the only one he described, *viz.*, *O. faujasi*.

The next point calling for comment in Stoliczka's report is regarding the beds from which his orbitoids came. He mentions two localities—(I) Niniyur, in white limestone, and (II) Chokanadapuram, in a pinkish earthy limestone—both of them belonging to the Ariyalur group of Blanford. According to Blanford's memoir, the white limestone in locality (I) would belong to his *upper* Ariyalur division which was Danian in age, while the pinkish earthy limestone of locality (II) would be in his *lower* Ariyalurs whose age was Senonian. In the light of recent stratigraphical studies[3] it is clear that both these age indications for the orbitoidal beds are not correct. The white limestone (I) is *not* a member of the Danian Niniyur group as now defined[3]; it is a pre-Danian bed, just below the Niniyurs; the pinkish earthy limestone near Chokanadapuram (II) is *not* a bed belonging to the lower Ariyalurs—it is younger and belongs to the upper part of Blanford's "Middle Ariyalur" division. It is now evident that both the orbitoid-bearing beds referred to in the two localities mentioned by Stoliczka are younger than Senonian and older than Danian; their age would thus be Mæstrichtian.[5]

The suggestion arising from the first locality mentioned in Stoliczka's paper that the *O. faujasi* came from a 'Danian' bed led Kossmat twenty-five years later[2] to strengthen his correlation of the Nerinea beds in the Pondicherry area in which he said he had also noticed similar *Orbitoides* with the Danian, thus indicating a close analogy between the concerned beds in the two areas. But we now know that this correlation based on 'Danian' orbitoids is no longer true; for one thing, the orbitoid-bearing bed near Niniyur is not 'Danian' in age; and for another, Kossmat's *Orbitoides* in the Nerinea beds is not an *Orbitoides*.[4,5] From recent discoveries of more orbitoids in the Ariyalur area and the stratigraphical position of the containing beds, it is now almost certain that all the orbitoidal beds, including those mentioned by Stoliczka, are of Mæstrichtian age. This conclusion fits in nicely with all later studies, and eliminates the 'anomaly' regarding Danian orbitoids about which Vredenburg[6] was so much worried.

Now, to come back to *Orbitoides faujasi* itself. About thirty years after Stoliczka recorded the presence of this form in the Ariyalur area, Schlumberger described in 1901-02 two species of *Orbitoides* from the upper Cretaceous of Europe, *O. socialis* and *O. minor*, the genotype for the former being *Orbitolites socialis*, Leym. and that for the latter being *Orbitoides faujasi*, Stol. Thus on the basis of Schlumberger's studies, the old *O. faujasi* from the Ariyalur beds would now become *O. minor*.

An outstanding contribution to the study of Orbitoids was made a few years later when in 1907, Silvestri created the new genus *Lepidorbitoides* with *Orbitolites socialis* Leym.

as the genotype. A complete description was also given of this new genus and its diagnostic characters clearly indicated. This form is now so well known that it is hardly necessary to go into this description. The essential point to note is that after Silvestri's work, it was clear that the *Orbitoides socialis* of Schlumberger is really a *Lepidorbitoides* and should be called *L. socialis*. Not long afterwards, Douville recognised the *Lepidorbitoides* character of *O. minor* Schl. and this form became accordingly *L. minor*. Thus both the two important species of the so-called *Orbitoides* described by Schlumberger had now to be considered as species of *Lepidorbitoides* and designated *L. socialis* and *L. minor* respectively. In his 1916 paper, Douville went a step further and maintained that *L. minor* was practically the same as *L. socialis*, except for some differences in dimensions, and that it should therefore be treated merely as a variety of *L. socialis* and called *L. socialis*, race *minor*. Thus we find that the *O. faujasi* of Stoliczka (1873) became *O. minor* of Schlumberger (1901), and then *L. minor* of Douville (1916), and finally, according to Douville *L. socialis*, race *minor*.

We may at this stage refer to an important paper published by Vredenburg[9] in 1908 on "The Cretaceous Orbitoides of India". Vredenburg has here given a review of all the *Orbitoides* known till then from the Cretaceous of India, together with a brief description of the important species and their zonal distribution. There is naturally a reference in this paper to the South Indian *Orbitoides* also; following Schlumberger's view *O. faujasi* is here mentioned as a synonym of *O. minor*, and the *Orbitoides* noticed by Kossmat[2] in the Pondicherry area is considered as a new species 'undescribed' before and named *O. minima*. Judged by his description of these 'Orbitoides' it is clear that Vredenburg at the time of writing his review was not aware of Silvestri's studies (leading up to the creation of the new genus *Lepidorbitoides*) published at about the same time. Nevertheless Vredenburg's descriptions and comments, both stratigraphical and palæontological, made in the course of his paper are of great value in all subsequent studies of Indian Orbitoids.

After Silvestri's and Douville's work referred to above, rapid progress was made in the study of Orbitoids all over the world, and quite a large number of papers based on intensive studies were published from time to time, with the result that our knowledge of this important family of fossil Foraminifers has been considerably enlarged from all points of view. With reference to the subject-matter of the present article, special attention should be drawn to a paper by Thiadens[8] published in 1937 in which he has described 3 species of *Orbitoides* and 4 of *Lepidorbitoides* from the upper Cretaceous beds of Santa Clara Province, Cuba. One of the most important points discussed in this paper is regarding the view expressed by Douville that *L. minor* is not a distinct species, but is merely a variety of *L. socialis*. After studying the type material of both these forms from the Mæstrichtian beds of Holland and France respectively, Thiadens has categorically tabulated the diagnostic characters of both side by side, and shown that the two species, *socialis* and *minor*, are quite different and distinct, and that therefore Douville's view regarding their identity is altogether unacceptable. This means that the recognition of *L. minor* as a separate species is quite valid, and we can so go back to the idea that the *O. faujasi* of Stoliczka from the Ariyalur beds is the same as what should now be called *L. minor*.

More recently S. R. Narayana Rao[3] has raised another doubt about this. In the course of his paper published in 1941 describing a small collection of orbitoids from the Ariyalur beds near Chokanadapuram (one of the localities mentioned by Stoliczka for his *O. faujasi*) he states that Stoliczka's *O. faujasi* from this area is *not* the same as *L. minor* since the South Indian form differs in several 'structural characters' from the typical *L. minor* of Mæstricht (Holland). He has accordingly created a new species *L. blanfordi* and puts the *O. faujasi* of Stoliczka, and the *O. minor* of Vredenburg as synonyms of his new species. While it must be admitted that the case made out by S. R. N. Rao in support of his conclusion is not obvious from the brief descriptions and comparisons given by him, his suggestion is nevertheless important as indicating another possibility which it would be worthwhile to further investigate.

If only we could recover the entire collection of the Ariyalur Orbitoids which Stoliczka had before him in 1873 when he wrote his report, and re-examine them now on modern lines, it would indeed be a most valuable contribution in solving many of our doubts and difficulties regarding their exact nature and identity; but this is evidently out of the question. Luckily for us, however, we have quite recently found a very rich occurrence of orbi-

toids in some of the beds near Ariyalur.[6] This material is now being studied in detail by the present author, and a full paper on this subject will soon be published elsewhere. From the present collection it is clear that the Orbitoids in the Cretaceous rocks of South India are both rich and varied, affording opportunities for work of the greatest interest and importance; and when one is engaged in these studies, his mind frequently goes back to Blanford and Stoliczka whose pioneer investigations nearly a hundred years ago mark the starting point in this fascinating field of research.

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INDIAN AGRICULTURAL RESEARCH INSTITUTE, NEW DELHI, 1905-1955

THE Indian Agricultural Research Institute, New Delhi, popularly known as the Pusa Institute, is fifty-years-old this year and celebrated its Golden Jubilee from 1st to 4th April 1955. The Institute, whose establishment in 1905 at Pusa, Bihar, was facilitated by the liberal donation of £ 30,000 given by an American philanthrophist, Mr. Henry Phipps, to Lord Curzon was located at Pusa until the great Bihar earthquake of 1934 caused irreparable damage to the laboratory buildings. It was then decided to shift the Institute to New Delhi. An area of over 1,000 acres was acquired, new laboratories and buildings were constructed and Lord Linlithgow, the then Viceroy and Governor-General, declared the new buildings open in November 1936.

There are at present six major divisions within the Institute: (1) Agronomy, (2) Botany, (3) Soil Science and Agricultural Chemistry, (4) Agricultural Engineering, (5) Entomology, and (6) Mycology and Plant Pathology. Each of these divisions has separate buildings and experimental area. Besides the Central Library, which receives over a thousand different periodicals and is considered to be the best agricultural library in the East, the different divisions have libraries of their own. The Institute has also three substations at Pusa (Bihar), Karnal and Simla.

Among the early scientists on the staff of the Institute were such eminent authorities as Dr. E. J. Butler in the field of Mycology, Sir Albert Howard in the field of Plant Breeding and Prof. M. Lefroy and Dr. T. B. Fletcher in Entomology. Due to the interest and initiative of these men and the workers who followed them an extensive collection of varieties of crop plants the vast National Pusa collection of insects and the Herbarium Cryptogamæ Indiæ Orientalis have been built up and are now in constant use by research staff and students.

The Institute has had a fine record of achievement in the matter of contributions to both the fundamental and applied aspects of the different branches of agricultural science.

One of the important activities of the Institute is the provision of post-graduate training to students and deputees of Agricultural Departments from the different States of India. The students have the choice of nearly twenty different two-year courses for each of which there is a carefully planned syllabus. Hundreds of such trained men now occupy important positions throughout the country. Several students from neighbouring Asiatic countries are also now enrolling themselves for the post-graduate course at the Institute. During the past five years, the Central College of Agriculture which imparts undergraduate training leading to the B.Sc. Degree of the Delhi University is also located in the Institute.

Recently, the Institute has undertaken agricultural extension work in Delhi villages. Besides, it co-operates with the Food and Agricultural Organisation of U.N. in the maintenance and description of genetic stocks of wheat and with the Technical Co-operation Mission of the United States in conducting trials of certain fertilizers in different parts of India. On the eve of the Golden Jubilee, the Institute is on the threshold of further expansion. To satisfy the increased requirements of trained personnel in connection with the various agricultural development schemes put into operation under the Five-Year Plan, provision is being made for training more post-graduate students. A new hostel which can accommodate 100 more students has been constructed. On the research side, a laboratory for undertaking research on trace elements has been completed. A cartographic laboratory will also soon start functioning. Also, the existing laboratories are being provided with additional green houses and new equipment. With a tradition so rich the Institute may well look forward to the future with a sense of awareness of the part they can and should play in the betterment of crop production and animal husbandry in India.

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SCATTERING OF HIGH ENERGY NUCLEONS BY NON-UNIFORM NUCLEI

The following relation (Eq. 1) was derived by the authors[1] while dealing with the scattering of high energy nucleons by uniform nuclei :

$$(k_1/k) = [\{(E+V)^2 - \mu^2c^4\}/\{E^2 - \mu^2c^4\}]^{\frac{1}{2}} - 1 = (\pi\rho/k^2)\{f_{nn}(0) + f_{np}(0)\} \quad (1)$$

Here V is the depth of the nuclear potential well, f_{nn} (0) and f_{np} (0) are the forward scattering amplitudes for (*n*, *n*) and (*n*, *p*) scattering respectively to be evaluated within the nucleus, and ρ is the nuclear density. The complex refractive index of nuclear matter is then given by

$$n = 1 + (k_1/k) + i(K/2k) \quad (2)$$

It is possible to extend the method to spherically symmetric non-uniform nuclear density distributions by applying the above formalism at each point in the nucleus for a particular value of the energy. Table I gives the total cross-sections calculated in this way for the

scattering of 90 Mev nucleons by a number of light elements. The nuclear potential well for the scattering of 90 Mev nucleons was obtained by evaluating $f_{nn}(0)$ and $f_{np}(0)$ from the Jastrow[2] as well as the Christian[3,4] models for nucleon-nucleon scattering, using the non-uniform characteristic nuclear density distribution obtained by Gatha, Shah and Patel.[5] Using these potential wells the radial distributions of k_1 were determined. The radial distribution of the absorption parameter K was obtained from the formula

$$K=(\epsilon\rho/2)\{\sigma_{nn}+\sigma_{np}\} \qquad (3)$$

where ϵ is the exclusion factor, and σ_{nn}, σ_{np} are the (n, n) and (n, p) scattering cross-sections respectively to be evaluated within the nucleus. We have used $\sigma_{nn}=\sigma_{np}$ and evaluated σ_{np} from the curves given by Hildebrand[6] at the kinetic energies within the above potential wells. The exclusion factor ϵ has been left undetermined at this stage. The radial distributions obtained above can be closely fitted by the expressions:

$$k_1(\bar{r})=a_1\exp(-b\bar{r}) \qquad (4)$$

$$K(\bar{r})=\epsilon a_2\exp(-b\bar{r}) \qquad (5)$$

where $a_1=9{\cdot}2\times10^{12}$ cm.$^{-1}$, $a_2=23{\cdot}9\times10^{12}$ cm.$^{-1}$, for the Jastrow model and $a_1=14{\cdot}3\times10^{12}$ cm.$^{-1}$, $a_2=20{\cdot}8\times10^{12}$ cm.$^{-1}$, for the Christian model, while $b=1{\cdot}94\times10^{13}$ cm.$^{-1}$ for both models and $\bar{r}=r\times A^{-\frac{1}{3}}$ where A is the nuclear mass number.

To evaluate the total cross-sections σ_t for the scattering of 90 Mev. nucleons, the generalisation for non-uniform nuclei[7] was employed, which gave

$$\sigma_t=4\pi A^{2/3}\int_0^\infty \bar{\rho}\,d\bar{\rho}\,[1-e^{-\bar{a}\bar{\rho}K_1(b\bar{\rho})}\cos\{\bar{\beta}\bar{\rho}K_1(b\bar{\rho})\}] \qquad (6)$$

where $\bar{a}=\epsilon a_2 A^{\frac{1}{3}}$, $\bar{\beta}=2a_1A^{\frac{1}{3}}$ and $K_1(z)$ is the Bessel function of z in the usual notation. Using this expression σ_t was calculated for both the models and the results were compared with the experimental values of Cook *et al.*[8] If ϵ is taken to be 0·66 following Fernbach *et al.*[9] then the Jastrow model gives slightly higher values for σ_t while the Christian model gives about twice the experimental values. Thus the Christian model appears to be unsuitable for this purpose. Using the Jastrow model, the best agreement with the experimental results is obtained if $\epsilon=0{\cdot}58$. The values for σ_t calculated in this way are tabulated in Table I.

TABLE I

Element	Total cross-sections in millibarns	
	Theoretical	Experimental
Li ..	324	314 ± 6
Be ..	421	431 ± 8
C ..	548	550 ± 11
N ..	651	656 ± 21
O ..	734	765 ± 20
Mg ..	1035	1030 ± 20
Al ..	1162	1120 ± 20

The study thus indicates that the usual optical model formalism for uniform nuclear density distributions can be generalised to deal with the non-uniform nuclear density distributions and further that the characteristic nuclear density distribution proposed by the authors previously on the basis of the nuclear scattering of 340 Mev nucleons and the optical model parameters determined on the basis of the above formalism can reasonably account at least for the total scattering cross-sections at 90 Mev.

M. G. Science Institute, Navarangpura, Ahmedabad-9, *February* 15, 1955.

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FORCE CONSTANTS OF THE RADICALS OF XY_4 TYPE

WILSON[1] developed the group-theoretical method of obtaining the normal frequencies making use of the symmetry co-ordinates. In this method the elements of F and G matrices relating to the potential and kinetic energies respectively are obtained. From these matrices the equations giving the normal frequencies in terms of the force constants are deduced.

In the present investigation the force constants of four inorganic radicals all belonging to the symmetry group T_d have been calculated from the observed Raman frequencies which are taken from Landolt-Bornstein tables. In the following table, ν_1 corresponds

TABLE I

Radical	Observed frequencies				$f_d \times 10^{-5}$ dynes cm.$^{-1}$	$f_{d\alpha} \times 10^{-5}$ dynes cm.$^{-1}$	$f_\alpha \times 10^{-5}$ dynes cm.$^{-1}$	$f_{\alpha\alpha} \times 10^{-5}$ dynes cm.$^{-1}$	Calculated frequencies				d in Å Badger's rule
	ν_1	ν_2	ν_3	ν_4					ν_1	ν_2	ν_3	ν_4	
AsS_4	386	171	419	216	2·818	0·4135	0·3123	0·0570	386	171	437	207	1·87
SbS_4	366	156	380	178	2·534	0·5153	0·3669	0·1063	366	156	401	167	2·28
NH_4	3040	1680	3145	1400	5·495	0·5980	0·6144	0·0275	3040	1680	3147	1405	1·03
ND_4	2214	1215	2346	1065	5·829	0·6560	0·6285	0·0218	2214	1215	2360	1059	1·02

Details will be published elsewhere.

to the non-degenerate A_1 type vibration, ν_2 the doubly degenerate E type vibration and ν_3 and ν_4, the triply degenerate T_2 type vibrations. The procedure adopted here in the evaluation of force constants is similar to the one described by Cleveland.[2] The force constants f_d, f_α $f_{\alpha\alpha}$ and $f_{d\alpha}$ have the usual significance. As the equations involving the force constants do not yield real roots, the method of successive approximations has been used in this investigation and the force constants which form the best fit in the equations are evaluated. The observed frequencies, the force constants obtained in this investigation and the frequencies calculated therefrom are given in Table I. In the last column are given the internuclear X-Y distances as obtained from the f_d values of the present investigation, using Badger's rule.[3]

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CHROME PHENGITE FROM BELVADI, MYSORE STATE

MENTION of the occurrence of Fuchsite quartzites in Mysore has been made by the officers of the Mysore Geological Department[1] and the brilliant green mica contained in these rocks has been referred to as fuchsite, a chrome muscovite. The green mica occurring in one such quartzite from Belvadi, has been subjected to a detailed investigation of its optical properties, as a result of which we have now identified it as a phengite.

The mineral, under investigation, shows the following optical properties:

The relief is distinct with serrated borders and the birefringence is strong. It shows almost straight extinction and is pleochroic with the following scheme: X = pale greenish blue; Y = yellowish green; and Z = dark bluish green.

It is optically negative with $2V = 32°$, as determined on the Federov's Universal Stage. The refractive indices, β and γ of the mineral were determined by the immersion method while the α value was calculated from the other two values of the indices and the optic axial angle. They are: $\alpha = 1·558$, $\beta = 1·595$, $\gamma = 1·598$, and $\gamma - \alpha = 0·040$ $(-)\ 2V = 32°$.

When the β and $2V$ of the mineral are plotted in Winchell's variation diagram for the muscovite system of minerals,[2] it is found that the mineral is rich in phengite molecule.

The mineral has been kindly analysed for its chromium content by Sri. T. D. Bhasker, Department of Chemistry, Central College, Bangalore, and is found to contain 0·98% Cr_2O_3.

It is evident from the above optical and chemical study, that the mineral, under investigation, is a chrome mica which is a member of the muscovite system, being rich in phengite and poor in muscovite molecules. Hence it is a chrome phengite and not fuchsite. Further work involving chemical and X-ray analyses of this mineral from other localities in Mysore will be done and a more detailed paper embodying the results of such work will be published elsewhere.

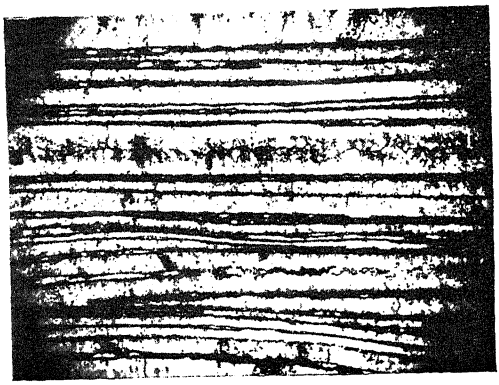
The authors desire to thank Dr. C. S. Pichamuthu for his interest in the work and valuable suggestions.

Dept. of Geology, M. G. CHAKRAPANI NAIDU.
Central College, A. MOHAMED KHAN.
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BANDED MANGANIFEROUS CHERTS FROM SRIKAKULAM DISTRICT

CHERTS usually brown, black and sometimes variegated, occur abundantly in association with manganese ores, and manganese bearing rocks of Visakhapatnam and Srikakulam Districts. They are found as irregular masses in the manganese ore body. The cherts occurring in manganese quarry of Echcherla (Sheet 65 N, Long. 83°-53′ and Lat. 18°-18′, 6 miles south-west of Srikakulam) collected by one of us (C. M.) show banding which has not been reported earlier. These consist of alternate bands of chert and manganese ore which are light and dark-coloured respectively (Fig. 1). The



manganese bands occasionally contain ferruginous material and garnet, the later often showing lenticular forms. The bands sometimes show miniature foldings. There are cracks in the bands and they are filled with manganese (Fig. 2). The chert shows devitrification, and



some small druses in the chert band contain minute crystals of quartz.

Fermor[1] considered the cherts associated with the manganese ores of these areas as due to the alteration of manganese silicates and deposition of the released silica in a colloidal state, but, it appears that these banded manganiferous cherts are sedimentary in nature. This conclusion is based on the fact that, the alternate banding of manganese and silica resembles stratification, a primary feature of sedimentary rocks. The banding is also more or less uniform and does not show much irregularity. Furthermore, the banding in the chert is parallel and conformable with the gneissosity of the associated paragneisses, and mineralogically, again, these are similar to quartz-manganese-garnet associations of Madhya Pradesh which are considered to be of definite sedimentary origin. Harold L. James[2] discussing a similar problem of the banded cherts suggested that they are of the nature of primary precipitates.

The occurrence of the garnets and the presence of ferruginous material in the manganese ore bands suggests the original impure nature of manganese deposition. The cracks and the druses found in the bands are suggested to be due to the space created on volume shrinkage during the process of devitrification of the colloidal silica. Finally, it may be stated that the origin of these banded manganiferous cherts is of considerable interest, suggesting an original sedimentary nature of the manganese deposits of these areas, similar to the manganese deposits of Madhya Pradesh.

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MEASUREMENT OF EXTINCTION ANGLES IN HORNBLENDES WHICH SHOW STRONG ABSORPTION

BUDDINGTON AND LEONARD[1] have commented on the difficulty of measuring accurately the extinction angles of hornblendes in north-west Adirondack granite rocks. These hornblendes showed strong absorption parallel to Y and Z, and weak absorption parallel to X. Hornblendes showing similar absorptions occur in Charnockites. The most reliable method of measuring extinction angles is on (100) twins of hornblende, as outlined by Turner.[2] Such twins do not occur in the hornblendes of Charnockites. Therefore, the following two methods were tried, both on the Fedorow stage. The use of the stage is after Reinhard.

(1) In a grain showing the emergence of both the optic axes, beta (Y) was located as also the emergence of the two optic axes. The pole of the cleavage trace was also located. These were drawn in stereographic projection (Fig. 1). The determination of the optic sign,

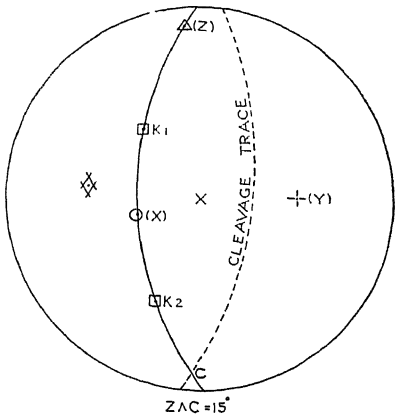


FIG. 1

in this case, negative, enabled the acute bisectrix alpha (X) to be located midway between the two optic axes. The third ellipsoidal axis, gamma (Z) may, if necessary, be located polar to XY plane. The trace of the cleavage plane is drawn, and its intersection with the XZ plane gives the emergence of C, and therefrom the angle Z∧C is measured in stereographic projection.

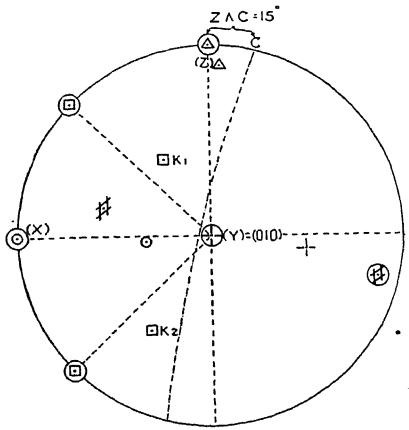


FIG. 2

(2) The second method is by the application of the Biot-Fresnel law of extinction. As before, beta (Y), the emergence of the optic axes, and the cleavage pole are located in strereographic projection. The stereogram is transformed with beta (Y) as the centre of projection. The constructions required by the Biot-Fresnel law are now drawn, the trace of the cleavage plane on (010) is C, and the angle Z∧C is read off in radian measure.

Both the above methods eliminate difficulties arising out of strong absorption parallel to Z, and the results are accurate to a degree. Determinations made on 10 grains gave values from 14-15°.

My sincere thanks are due to S. Ramanathan, Research Assistant of this Department, for furnishing the above data from his study of Hornblendes of Charnockites from Salem.

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PREPARATION OF *o*-BROMACETOPHENONE

THE procedure of Elson, Gibson and Johnson[1] for the preparation of *o*-bromacetophenone is cumbersome and gives poor yields because of the difficulties in nitration and reduction. The same substance can be synthesised in good yields by reduction of the diazoketone obtained from ortho-bromo-benzoyl chloride, with hydriodic acid.

Ortho-bromo-benzoic acid[2] (5·0 g.) was treated with thionyl chloride (10 ml.) in the cold, and the acid chloride formed at the end of about 2 hours was distilled; b.p. 150° C./22 mm. Yield, 4 g. A solution of the acid chloride (4 g.) in dry ether (20 ml.) was added in small quantities, to a solution of an excess of diazomethane (3-4 moles.) in dry ether. After careful removal of the solvent by evaporation, the resulting diazoketone was taken up in chloroform (15 ml.) and shaken with excess of hydriodic acid (15 ml., d. 1·72). The reaction mixture was then decomposed by treatment with an aqueous solution of sodium sulphite and extracted with ether. Removal of the solvents left the o-bromacetophenone as a liquid, b.p. 92° C./2·5 mm. Yield, 3 g. It was further characterised by its oxime, 2 : 4-dinitrophenylhydrazone and semicarbazone[1] derivatives. Oxime (crystallised from alcohol), m.p. 130-32°. Found: N, 6·7; C_8H_8ONBr requires N, 6·5%. 2 : 4-Dinitrophenylhydrazone (crystallised from alcohol), m.p. 203°. Found: N, 14·7; $C_{14}H_{11}O_4N_4Br$ requires N, 14·8%.

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TWIN LAWS OF PLAGIOCLASE FELDSPARS OF GRANITES, GNEISSES AND ASSOCIATED ROCKS OF CLOSEPET (RAMANAGARAM), BANGALORE DIST.

PLAGIOCLASE feldspars from granites, gneisses and associated rocks occurring in an area of about 112 square miles around Closepet were examined on the universal stage. Two hundred and thirteen grains in 39 rock sections cut from 11 rock types were determined for the anorthite content and twin laws according to the method of Reinhard.[1] The distribution of twin laws in various rock types is shown in the table.

	Rock Type	% Anorthite	Normal Law: Albite	Normal Law: Manebach	Normal Law: Baveno	Parallel Law: Carlsbad	Parallel Law: Aklin = Manebach Ala	Parallel Law: Ala = Manebach Aklin	Complex Law: Albite-Ala	Complex Law: Albite-Carlsbad	Complex Law: Combined Albite-Pericline
1	Pink porphyritic granite	23–27	10	1	..	..	2	..	13	..	..
2	Grey porphyritic granite	23–30	6	..	..	..	1	..	5	1	3
3	Coarse grained Closepet granite ..	20–27	9	1	.	..	2	..	12	..	2
4	Medium grained grey granite	22–27	14	..	..	..	..	..	5	..	2
5	Medium grained pink granite ..	22–25	..	1	..	..	..	..	..	..	..
6	Medium grained pink and grey granite ..	22–28	1	1	..	..	1	..	2	..	..
7	Fine grained grey and pink granite ..	23–25	1	..	..	..	..	..	..	..	..
8	Syenite ..	23–35	11	2	..	2	2	..	6	5	..
9	Banded gneiss ..	22–33	17	1	..	2	4	..	18	3	4
10	Hornblende Schist ..	20–33	7	2	..	1	1	..	6	2	1
11	Amphibolite ..	27–37	10	..	..	..	..	..	7	..	3
	Total (213) ..		86	9	..	5	13	..	74	11	15

It will be significant from the table that the plagioclases in all the rock types of Closepet are acid oligoclases containing 20-28% anorthite. The plagioclases in syenites, banded gneisses, hornblende schist and amphibolite are basic oligoclases with 30-37% anorthite.

Albite law is the most abundant twin law (86) followed by albite Ala B law (74). The combined albite-pericline law (15) is less common, but slightly more abundant than the rest of the laws.

From this statistical study of twin laws, it appears that in the Closepet Granite complex we are dealing with injection metamorphism. A detailed petrographic and chemical study of the rocks of the area is under progress.

The nature of simple, parallel and complex laws was checked by constructing the pole of the twin axis by Nikitin's method. The now well known conflict between albite law and albite Ala B law occurred for plagioclases of composition 25-29%. (Raghavan,[2] Ramanathan[3] and Coulson[4]). The conflict was resolved by applying Coulson's check and Nikitin's construction.

Coulson has indicated the frequency of albite Ala B twins in plagioclases of 33% anorthite. The author, however, has noted the frequent occurrence of albite Ala B twins in plagioclase feldspars of 22-27% An in the rocks of Closepet region. Similar evidences have been noted by Raghavan and Ramanathan in their areas.

The author is grateful to Dr. P. R. Jagapathy Naidu for his guidance in the present work, and to Dr. M. G. Chakrapani Naidu for his helpful suggestions.

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THE COLOURING MATTERS OF PONDEROSA PINE BARK

In a recent note Gupta, Kurth and Seshadri[1] have described the isolation of 2 : 3-dihydroquercetin (taxifolin) from the bark of *Ponderosa* pine. Comparison of R_f values in paper chromatography and colour reactions have also led them to suggest the presence of quercetin and myricetin. Methylation of the total colouring matters and alkali fission gave 2-hydroxy-ω : 4 : 6-trimethoxyacetophenone, veratric acid and trimethylgallic acid, which "indicated that a mixture of quercetin and myricetin was involved". Our examinaton of the Ponderosa colouring matters[2] has yielded substantially different results, which will be discussed fully in a paper to be shortly communicated to the *Journal of Scientific and Industrial Research*.

The crude *Ponderosa* colouring matter (m.p. 275-85°) gave a test for flavononols, and taxifolin was isolable from the aqueous extract. Extraction with petroleum ether indicated the presence of about 2% of wax. The crude colouring matter was chromatographed on a column of Florex, using ethyl acetate (in which 94% was soluble) as solvent. The percolate yielded a yellow substance, which gave neither the gossypetone test nor the green colour with aqueous potassium carbonate given by the crude colouring matter. Crystallization of this material from aqueous acetone led to quercetin. Concentration of the mother liquor obtained from the crystallization of quercetin yielded a substance which was methylated with dimethyl sulphate and potassium carbonate in acetone. The product separated into two fractions when a benzene solution was chromatographed on alumina; one was quercetin pentamethyl ether, and the other, m.p. 164°, was the pentamethyl ether (I) of a pentahydroxy-C-methylflavone to which the name pinoquercetin may be assigned. On a column of powdered cellulose, using a mixture of either butanol, acetic acid and water or *m*-cresol, acetic acid and water[3] as solvent, the crude colouring matter was separable into two fractions, one giving a green colouration with aqueous potassium carbonate and the other not answering this test. The former fraction contained a new flavonol, which it is proposed to designate as pinomyricetin. Acetylation with acetic anhydride and pyridine gave a derivative, m.p. 228-30°, analysing for a hexacetoxy-C-methylflavone. On methylation with dimethyl sulphate and potassium carbonate in acetone a hexamethoxy-C-methylflavone (II), m.p. 178°, was obtained.

When the crude *Ponderosa* colouring matter was methylated with dimethyl sulphate and potassium carbonate in acetone and the product was fractionated by a procedure involving crystallization as well as chromatography on alumina, three crystalline polymethoxyflavones were obtained: (1) quercetin pentamethyl ether; (2) pinoquercetin pentamethyl ether (I), m.p. 164°; and (3) the hexamethyl ether (II), m.p. 178°, of pinomyricetin. Alkali fusion of both the polymethoxy-C-methylflavones (I) and (II) gave the same ketone, identified by synthesis as 2-hydroxy-4 : 6 : ω-trimethoxy-5-methylacetophenone; in addition, (I) gave veratric acid, and (II) trimethylgallic acid. Pinoquercetin is therefore 6-methylquercetin,[4] and pinomyricetin 6-methylmyricetin. Strobochrysin is the only C-methylflavone whose occurrence in nature has been previously recorded,[5] although C-methyl-derivatives of chromones, flavanones and flavononols have been found in plants.

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NUTRITIVE VALUE OF BAMBOO SEEDS (*BAMBUSA ARUNDINACEA*, WILLD.)

Bamboo seed—popularly known as 'Bamboo Rice'—is a reputed famine food. It has been reported[1] that thousands of people sustained themselves on these seeds in times of scarcity in the past. Normally it is only consumed by the hill and forest tribes. Although the bamboo flowers once—and once only—towards the end of its life-span of 15-20 years, very large quantities of the seeds are said to be available during the season in the tracts where bamboos abound. Apart from the chemical composition of some varieties,[2,3] there is little information on the nutritive value of the seeds. Investigations on this aspect were, therefore, undertaken in this laboratory as part of a programme of work on little known foods.

The husked seeds grossly resembled rice, but closer examination showed that they were more like wheat. As compared with rice, the grains had a thicker and tougher bran-coat which was difficult to polish completely. The fully, or partially, polished grains cooked like rice but were slightly more glutinous. Unpolished grains required a longer time for cooking. The grains could be consumed either in the cooked form or as various culinary preparations (*chappatis*, etc.), made out of the flour.

The percentage composition of the husked seeds was as follows: moisture 10·0, crude protein 12·0, ether extractives 0·9, ash 1·1, fibre 2·6, carbohydrates (by difference) 73·4, calcium 25·0 mg.%, phosphorus 218·0 mg.%, iron 9·2 mg.%, vitamin B_1 0·1 mg. (33·3 International Units)%, nicotinic acid 2·03 mg.%, riboflavin 36·3 μg.%, carotene 12 μg.% (20 International Units of vitamin A) and calorific value 98·0 calories per ounce. Fractionation studies revealed that the major proteins of the seed were glutelins with isoelectric point at pH 4·6. The amino acid make up of the proteins—as determined by the two-dimensional paper chromatographic procedure developed in this laboratory[4]—showed that they were well provided with all the essential amino acids.

Employing rat-bioassay procedures,[5,6] the digestibility coefficient, biological value and protein efficiency ratio of the seed protein were determined at a dietary level of 10%, using the whole seed as the protein source. The effect of complete substitution of rice by the bamboo seed in a conventional poor rice diet[7] on its over-all nutritive value was also ascertained by rat-growth experiments. The results are summarised in Table I.

TABLE I

Nutritive value of bamboo seeds

Nutritive value of Protein		
Digestibility Coefficient	..	90·1 ±0·96
Biological Value	..	74·4 ±1·44
Protein Efficiency Ratio	..	1·96±0·07
Replacement Value in Rice Diet		
	Growth Rate (g. per rat)	
	per week	per 100 g. food ingested
Poor rice diet	.. 5·1±0·36	7·9±0·37
Bamboo rice diet	.. 7·9±0·37	12·8±0·65

It is evident from the above results that the biological value of the bamboo seed proteins is as high as that of rice proteins and higher than that of wheat proteins. In the matter of protein content, the seeds are comparable with wheat but superior to rice. The complete replacement of the rice in a poor rice diet by the seeds enhances its growth-promoting value by about 50%. Thus, in over-all nutritive value, the seeds excel both rice and wheat.

Our grateful thanks are due to Dr. V. Subrahmanyan for his keen interest in the work and to the Provincial Silviculturist, Ootacamund, for the supply of bamboo seeds.

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SEPARATION OF SILVER, MERCUROUS AND LEAD IONS BY CIRCULAR PAPER CHROMATOGRAPHY

EMPLOYING the "ascending" and "descending" techniques of paper chromatography it has been found[1] that nearly 10-15 hours or even more are required to effect the separation of inorganic ions. Circular paper chromatography has been adopted in this laboratory to separate the ions and it has been noticed that the interval of irrigation could be considerably reduced. The following is the outline of the method employed for the separations of silver, mercurous and lead ions.

About 0·05 ml. of the solution containing silver, mercurous and lead nitrates (0·05 M with respect to each salt) is spotted at the centre of a filter disk (Whatman No. 1 or No. 3) about 20 cm. in diameter and allowed to dry for about 30 minutes. The filter disk is then irrigated by solvents as described by Giri and co-workers,[2] in a closed chamber for about 2-4 hours. The solvent travels about 9 cm. from centre during this interval. The filter disk is then removed, dried at room temperature and sprayed with ammoniacal hydro-

gen sulphide from an all-glass sprayer[3] to develop the bands. The R_f value of each band is measured. The individual ions are also subjected to an identical treatment and R_f values are determined for each solvent. It is thus possible to identify the individual ions after the separation. The specific reagents for the metallic ions have also been used to identify the metals.[4] Lead, mercury and silver were identified by sodium rhodizonate (blue), diphenyl carbazone (violet), and p-dimethyl-amino-benzylidene-rhodanine (red-violet) respectively.

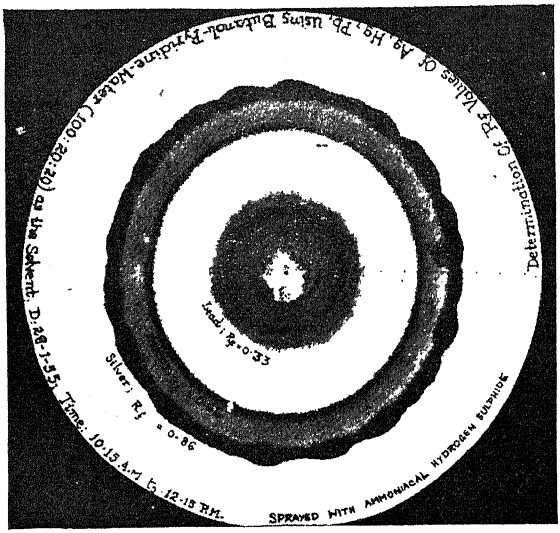


FIG. 1, Determination of R_f values of Ag, Hg, Pb, using Butanol-Pyridine-Water (100 : 20 : 20).



FIG. 2. Separation of Ag, Hg, and Pb using Butanol saturated with 4N acetic acid.

The main features of the results obtained are presented in Table I.

TABLE I

	Solvent	Time of irrigation for the solvent to travel 9 cm.	R_f values of metallic ions			Remarks
			Ag^+	Hg^+	Pb^{++}	
1	Butanol–Pyridine–Water[5] 100 20 20	2 hours	0·86	0·62	0·34	Photograph of the chromatogram is given in Fig. 1
			0·87	0·65	0·33	All the three ions get clearly separated
2	Butanol saturated with 4 N acetic acid[6]	2·25 hours	0·44	0·75	0·48	Photograph of the chromatogram is given in Fig. 2
			0·43	0·77	0·45	Silver and lead travel very close to each other. Mercury moves faster with the solvent
3	Collidine saturated with 0·4 N nitric acid[7]	3·5 hours	0·97	Very little movement		Both Hg and Pb give a diffused patch which is not clearly moved and separated from the centre
			0·95			Ag moves practically along with the solvent and can be separated from the other two

It can be readily seen that butanol pyridine water is a suitable irrigant to separate all the three ions from a mixture containing Ag^+, Hg^+, Pb^{++} in solution.

Various factors such as concentration, pH, method of spotting and irrigating, period of irrigation, etc., influence the R_f values of the individual ions. All these factors are under detailed investigations.

The authors are thankful to Prof. K. R. Krishnaswami, for his keen interest in the work and kind encouragement.

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DEPENDENCE OF HYSTERESIS IN LOW FREQUENCY ELECTRIC DISCHARGE ON ELECTRODE SURFACE

IT is known that as the potential applied between the two electrodes of a discharge tube is increased, a value is reached at which the current passing through the system begins to rise abruptly.[1,2] At this voltage, the medium breaks down as a dielectric and the so-called secondary processes become operative[3]; it is referred to as the threshold or breakdown potential (V_s). The curve representing the variation of the current i with applied potential (V) is characteristic of the system. Further, as the potential is decreased from above the breakdown voltage to values less than V_s the current does not follow the former characteristic but instead, a slightly curved path towards the origin[4] thus resulting in a hysterisis loop (*cf.* Fig. 1 A). This arises primarily on account of the difference between the breakdown potential V_s and the maintenance potential V_m upto which the enhanced current could be maintained; usually $V_s > V_m$. The existence of the above hysteresis loops in discharges with alternating fields and metallic electrodes has been well studied by Reich and others.[4,5] The present note reports an investigation of the hysteresis loops in low frequency (50 cycles/sec.) electric discharge in iodine vapour with glass electrodes on which no information exists in the literature; these studies have further revealed, for the first time, the marked dependence of the hysteresis on the nature of the electrode surface especially the gas layers adsorbed thereon.

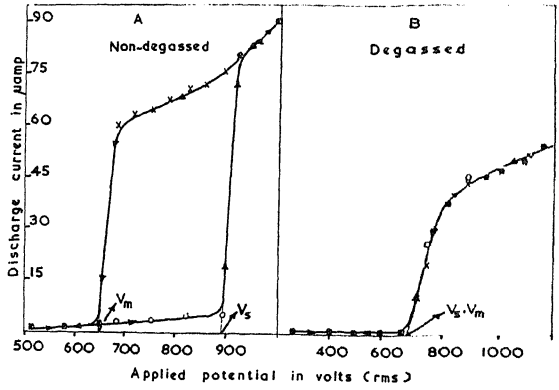


FIG. 1. Potential vaeiation of the discharge current representing the hysterisis in low frequency (50 cycles/sec.) electric discharge in non-degassed (A) and degassed (B) vessels.
Pressure of iodine vapour = 0·44 mm. Hg (30° C.).

Cylindrical glass vessels fitted with external sleeve electrodes, such as those first used by Wiedeman and Ebert,[6] were employed in the present investigation. Two series of experiments were carried out: in the first series (*A*), the discharge tubes as prepared from the available glass tubing were evacuated and then filled with pure iodine vapour at a desired pressure; in the other (*B*), the pre-adsorbed layers of H_2O, etc., commonly held by glass surface[7] were removed by degassing the vessel, *i.e.*, by heating under vacuum to 200° C. and condensing the gases in a liquid air trap,[2,3] and then filled (at 30° C.) with iodine vapour at the same pressure as in *A*. A typical series of results representing the characteristic curves (V *vs.* i) and the hysteresis loop in *A* and *B* are given in Fig. 1. It was interesting to note that the breakdown voltage V_s in a non-degassed vessel, *i.e.*, from which the pre-adsorbed H_2O vapour layers were not removed, was appreciably high; and decreased with degassing the vessel. Thus when the pressure of iodine vapour was 0·44 mm. Hg, V was 910 volts (r.m.s.) in the former case and 700 in the

degassed tube. Further, in the non-degassed vessel there was a marked difference between the breakdown voltage V_s and the maintenance potential V_m thus giving an appreciable hysteresis loop (Fig. 1 A). It was remarkable that this last was not noticed in the degassed vessel (Fig. 1 B) indicating thereby the marked dependence of the hysteresis, in the discharge under investigation, on the nature of the surface.

Similar studies were carried out in the presence of external radiation and with external circuit resistances, when the hysteresis was less predominant. The details and the theoretical considerations arrived at from these results will be presented elsewhere.

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PREVENTION OF CHOLINE TOXICITY IN RATS

CHOLINE CHLORIDE has been reported by Hodge[1] to be highly toxic on rats by intraperitoneal route; expressed as mg. per 100 g. body weight the LD_{50} value is 59-75 for a solution containing 20 mg. per c.c. Lethal dose for several species has been reported to be 40-60 mg. per kg. body weight intravenously.[2] Halliburton,[3] Lohmann,[4] Chevalier[5] and Gautrelet,[6] have shown that choline has a vasodilator effect.

Choline chloride, in a commercial preparation of B Complex (Parenteral) which was used, occurs as 25 mg. per ml. and with 0·5 ml. of it rats died with shock when injected intravenously. The nature of reactions was similar to that as has been described for choline chloride on rats by intraperitoneal route, *e.g.*, death preceded by respiratory paralysis, trembling, convulsive movements, salivation and hemorrhage around the eyes.

The toxicity of choline chloride was confirmed on a number of albino rats in our laboratory and was found that no other member of B vitamins [*e.g.*, thiamine hydrochloride or mononitrate (B_1), pyridoxine hydrochloride (B_6), riboflavin (B_2), nicotinic acid amide (NAA) and *d*-pantothenyl alcohol] was toxic to the rat by intravenous route in the quantity as occurs in 0·5 c.c. of the B Complex preparation. Each c.c. of the B Complex preparation used contains: B_1 25 mg.; B_2 1·0 mg.; B_6 2·5 mg.; NAA 50 mg.; choline 25 mg.; pantothenyl alcohol 5 mg.

Rats were injected with individual solutions of all the members in the same concentration which appear in the preparation in dose of 0·5 ml. intravenously and was found that all the members were equally non-toxic in this dose except choline; choline chloride either alone or in the group with other members produced toxicity in the same manner.

In this investigation various supplements were tried especially of four different types, *viz.*, vasoconstrictors, antihistamines, diuretics and detoxicants to see if the toxicity of choline could be counteracted with any of them on rats.

Rats weighing between 150 and 160 g. both male and female were used for the experiment as difference in toxicity in the sex was hardly observed. The various solutions administered on rats were all from sterile vials. As for the choice of various supplements used, consideration was given to the (*a*) vasodilator property of choline and was tried with several vasoconstrictor substances, such as adrenaline and ephedrine, either alone or in combination; (*b*) histamine-like responses and was tried with some antihistamines, like phenylbutazone, benadryl, chlortrimetonmaleate; and (*c*) toxicity in general and was tried with a few known detoxicants,[7] *e.g.*, methionine and glycine; and diuretics, *e.g.*, sorbitol and urea. Since there was no difference in toxicity in the trials with choline chloride alone or B Complex solution as a whole, all experiments were performed with B Complex solution and various supplements were mixed with B Complex solution.

Choline chloride in dose of 12-13 mg. was found to be lethal to rats by intravenous route. Although choline has been referred to as a vasodilator, nevertheless toxic symptoms did not appear to be due to vasodilation as none of the vasoconstrictors used neutralised the effect. Antihistamines were also equally ineffective in counteracting the toxicity. Amongst the detoxicants it was found that though methionine has been classed as a detoxicant, it did not help in rats; whereas glycine showed pronounced detoxifying action. Results with diuretics, *e.g.*, sorbitol and urea were inconclusive. It was observed that there was no toxi-

city in the alkaline B Complex solution (made alkaline just before injection; pH 8·0).

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OXYSPORIN, A NEW ANTIBIOTIC FROM *FUSARIUM OXYSPORUM* SCHLECHT

DURING a survey on antibiotic production by species of *Fusarium*, it was observed that a large number of strains of *F. oxysporum* Schlecht, among other species, showed varying levels of activity. Among the sixteen strains tested, seven were found to be active, and strain 549, originally obtained from the Ministry of Agriculture, Government of the Republic of Argentina, exhibited maximum antibiotic action.

Subsequent isolation, and examination of the properties,—chemical and biological,—of the anti-bacterial substance revealed that it did not resemble any of those compounds previously isolated from this species. The term "oxysporin" has, therefore, been employed to designate this new antibiotic.

The production of antibiotics by strains of *F. oxysporum* Schlecht has been found, by Gäumann and associates,[1] and Plattner, Nager and Boller,[2] to vary with individual strains. It was observed that the various strains of the species produced varying types of antibiotic compounds with different molecular formulæ, melting point and other properties, as outlined in Table I.

TABLE I

Antibiotic production by F. oxysporum *Schlecht*

Strain No.	Name of antibiotic	Formula	m.p. °C.	$[\alpha]_D^{24-42}$ in $CHCl_3$
ETH 1523	Enniatin-A	$C_{24}H_{42}O_6N_2$	121–122	− 91·9°
ETH 1574	Enniatin-B	$C_{22}H_{38}O_6N_2$	173–175	−107·9°
ETH 1524	Enniatin-C	$C_{22}H_{38}O_6N_2$	152–153	−104·4°

Preliminary studies indicate that oxysporin possesses melting point below 70° C. and has very high *in vitro* activity against *M. tuberculosis*. Table II represents the activity of the antibiotic against *Mycobacterium tuberculosis* var. *hominis*, strain H 37 Rv. in Youmans' medium.

TABLE II

Activity of Oxysporin in vitro *against* Mycobacterium tuberculosis *var.* hominis *H 37 Rv*

Readings made at the end of	Oxysporin in μg./ml.				
	1000	100	10	1	0·1
1st week	−	−	−	−	−
2nd week	−	−	−	−	++
3rd week	−	−	−	+	++

− total inhibition; + partial inhibition; ++ full growth.

Preliminary investigations of the *in vivo* activity of this antibiotic in experimental murine tuberculosis have indicated that oxysporin exhibits activity almost equivalent to that of streptomycin. Results of detailed studies on the chemistry and pharmacology of this antibiotic will be reported elsewhere.

Thanks are due to Dr. K. P. Menon for his keen interest in this investigation.

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THE ABO BLOOD GROUPS OF KUMAONIS

NUMEROUS anthropological blood groups surveys of various communities have been carried out. These have been tabulated by Boyd[1] and Mourant.[2]

The blood group distribution of the people of Kumaon (in Uttar Pradesh) does not appear to have been investigated previously.

The distribution of the ABO groups in 111 Kumaoni blood donors was found to be as under :

O	..	27	24·324%
A	..	30	27·027%
B	..	38	34·234%
AB	..	16	14·414%
Total	..	111	99·999%

The gene frequencies calculated by the method of Bernstein[3] (1930) are as under:

$$p = 0{\cdot}23344$$
$$q = 0{\cdot}28179$$
$$r = 0{\cdot}48474$$

The percentages of the expected phenotype frequencies, derived from the estimated gene frequencies, and those of the observed phenotype frequencies are compared in Table I.

TABLE I

	Observed	Expected
O	24·324	23·497
A	27·027	28·081
B	34·234	35·260
AB	14·414	13·156
Total	99·999	99·994

χ^2 for testing the goodness of fit is 0·243 for one degree of freedom. The deviation of the observed from the expected values is not statistically significant.

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AN ALTERNATIVE CONVENTION FOR pH

SORENSEN[1] introduced the convention of pH such that, $pH = -\log [H\cdot]$. In this convention, an inconvenient negative number is avoided by changing not only the sign of the characteristic, which is usually negative here, but also that of the mantissa of log $[H\cdot]$ which is always positive. Instead, this may be made simpler by avoiding the negative sign of the characteristic alone by adding 14 to it, leaving the mantissa as such. The number 14 is chosen since the characteristic of log $[H\cdot]$ rarely exceeds 14 in absolute magnitude and also since it is the absolute magnitude of the exponent of the accepted average value of the ionic product of water at about 25° C.

An alternative convention of L_H for expressing hydrogen-ion concentration is, therefore, suggested, such that

$$L_H = 14 + \log [H^\bullet]$$

This new convention has the following advantages over pH:

1. It is more rational and logical since it expresses the hydrogen-ion concentration in terms of its own logarithm.

2. L_H has a direct relation to H-ion concentration which is much better than the inverse relation between H-ion concentration and pH.

3. Interconversions of $[H^\bullet]$ and L_H are much easier than those of $[H^\bullet]$ and pH, as can readily be seen.

4. The pH of a buffer composed of a weak acid and its salt with a strong base is given by the relation:

$$pH = pK + \log \frac{[Salt]}{[Acid]}$$

A similar relation can be derived for the L_H of the same buffer, *viz.*,

$$L_H = L_K + \log \frac{[Acid]}{[Salt]}$$

From the above equations it can be seen that, for a given concentration of salt, as the concentration of the acid *increases*, the L_H of the buffer *increases* whereas its pH *decreases*. This again is a direct relation, with its added advantage and simpler mode of calculation, compared with the inverse relation in case of pH.

5. Starting from the ionic product of water, *i.e.*, $[H^\bullet]\,[OH'] = 10^{-14}$ (on average), it can be shown that

$$pH = -\log [H^\bullet] = 14 + \log [OH']$$

Thus, in expressing $[H^\bullet]$ in terms of pH, we are actually expressing it in terms of [OH'] or of log [OH'] adding 14 to it, while by adding the same 14 to log $[H^\bullet]$ and expressing it as L_H a more elegant method of expressing H-ion concentration is obtained.

It may be remarked that this addition of 14 to a logarithm to make it positive and convenient, is nothing unusual. Such a practice has long been adopted by mathematicians in adding 10 to the logarithm of sine and of cosine, to avoid their negative characteristics.

The changing over from pH to L_H need not present any difficulty to text-book writers and other authors, because of the simple relation:

$$L_H = 14 - pH$$

Hence, the pH values of buffer tables can easily be changed to L_H values by substituting $(14 - pH)$ as L_H, without changing the composition of the buffer.

To avoid any typographical difficulties in printing, "eH" (meaning: 'enhanced or enlarged exponent of $[H^\bullet]$'), may be used instead of L_H.

Further details will be published elsewhere.

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OSTEOLOGY OF CATFISHES

TATE REGAN[7] in his classification of the Ostariophysi remarked that the order included a number of genera which varied in form and appearance but uniformly possessed the remarkable Weberian apparatus. Siluroids form a large bulk of the order Ostariophysi including 28 families (Berg[1]). These have undergone many interesting modifications in various directions. The gas-bladder is modified to suit air-breathing habits and the Weberian apparatus is closely connected with this. Bridge and Haddon[3] stated: "It is remarkable that this important group of fishes have so little occupied the attention of morphologists, especially when we take into consideration the interesting modifications which its various members have undergone.....". Very little work has been done on the osteology of catfishes in India with a view to assessing its usefulness in systematics. No work has been done on the development of skull in any Indian catfish. Kindred[4] however, has studied the development of skull of an American form, *Amiurus*. An account of the adult morphology of the skull in a few Indian catfishes is given by Bhimachar[2] and in *Eutropiichthys* by Kumar.[5]

Representatives of six families, *viz.*, Siluridæ, Bagridæ, Amblycipitidæ, Akysidae, Sisoridae and Olyridæ have been selected for the study of adult cranial morphology. In addition, the development of the chondrocranium is being studied in *Silonia*, *Pangasius* and *Ailia* (Family: Schilbeidæ), in order to find out if these studies help in tracing their interrelationships.

The chondrocranium of *Silonia* (2 mm. head-length) exhibits a few interesting features. The roofing cartilages are absent and the hypophysial fenestra is spacious, extending from the ethmoid plate to the basal plate.

In the visceral arches, the pterygoid cartilage arises independently and articulates anteriorly with the ethmoid region. The quadrate is fused with hyomandibular cartilage as in other catfishes described. This peculiar feature is also noticed in a few other fishes like *Clupea* (Wells[9]) and *Ophicephalus* (Srinivasachar[8]). It is difficult to understand the significance of this fusion.

Normally in the teleosts, the upper jaw of the adult shows a methyostylic suspension and this is also seen in the siluroids I have examined. But in the case of one genus studied, *Batasio* (Family: Bagridæ) the pterygoid of the upper jaw gains an articulation with the orbito-sphenoid bone by an articular facet, in addition to the usual hyomandibular articulation in the otic region. This is an unusual feature. Additional articulation of the entopterygoid of the upper jaw with the prevomer bone has been reported by Ramaswami[6] in *Pseudorasbora*, a cyprinid fish.

A complete account of the chondrocranium and osteocranium of the above forms will be published elsewhere.

I am grateful to Dr. L. S. Ramaswami for guidance, to Prof. B. R. Seshachar for his helpful criticisms and to Dr. S. L. Hora for encouragement.

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ABNORMALITIES IN THE FLOWERS OF *DOLICHOS LABLAB, VULGARIS SAVI.*

SEVERAL abnormalities observed in the flowers of *Dolichos lablab, vulgaris* Savi. at Pilani are briefly recorded below:

PETALS.—(1) In addition to the normal posterior standard, another standard had developed; (2) Some showed three wings; some others showed two free keels laterally towards the sides while the anterior side was occupied by a sixth petal in some others; (3) Seven petals were found in some flowers, one standard, two wings and one normal keel, while the three others were more resembling wings.

STAMENS.—In the staminal whorl a number of abnormalities were noted. Instead of the ten normal stamens in two bundles of one and nine, twelve stamens were found in a number of cases. Two posterior stamens were found to be fused with the standard, the balance ten being disposed of in two bundles with varying numbers in each ($5+5+2$, $8+2+2$, $11+1$, $5+5+1$). In one flower the posterior stamen was converted into a petaloid staminode

of extra big size and the rest were in two bundles of five each. In one of the bundles of five, a half anther alone was transformed into a petaloid staminode. There were also a few cases where two stamens had fused and the two anthers were found on the same filament. In one odd case the filament had become flat and petaloid bearing two anthers one on each side.

PISTIL.—The gynæcium was found to be composed, in a number of cases, of two and three carpels which were either free or united either completely or by the basal portions of the ovaries only leaving the styles and stigmas free. In a few cases the carpels were found to be open with the ovules visible outside partially. In one case the ovules were definitely located outside the open carpels. However, none of these polycarpellary gynæcia developed into fruits. Microtome sections of the ovules from such gynæcia showed that the embryo sac had developed; but the contents were found to disorganise as the ovules progress in their development. Artificial pollination with self- and cross-pollen was also tried, but with no effect.

The author is indebted to Dr. B. N. Mulay, for valuable help.

Dept. of Botany, S. K. PILLAI.
Birla College of Science,
Pilani, Rajasthan,
November 10, 1954.

ON THE NATURE OF PRIMARY VASCULAR TISSUE IN THE TENDRIL OF *VITIS PALLIDA* W. & A.

So far as the writer is aware no study has been made of the nature of primary growth in the tendril of *Vitis*. Some observations made on *Vitis pallida* W. & A. indicate that there are about 23 primary xylem groups. The secondary xylem at the basal portion is in the form of radiating strands of xylem fibres and a small number of vessels, alternating with the broad parenchymatous xylem rays which give a characteristic lamellate appearance similar to that of the stem (Metcalfe and Chalk[1]). But this pattern of secondary growth may not be observed in the other part of the tendril. In a young tendril in which primary growth has not been completed, the vascular meristem appears to consist of 7-8 procambial strands arranged in a ring-like manner. They are connected to one another by strips of the residual meristem. Some of the cells of residual meristem divide tangentially and form additional smaller vascular bundles among the large ones and the protophloem and protoxylem cells may develop simultaneously. But sometimes only a single or more tracheary elements are first observed in the initial development of such a vascular bundle. Later a typical cambium was observed. Obviously the interfascicular part of the cambium ring has developed from differentiated residual meristem cells. According to Mclean and Cook,[2] the residual meristem in *Vitis* forms parenchyma cells which later give rise to the interfascicular cambium.

The question arises as to whether the vascular bundles developed from the residual meristem are primary or secondary. They are described here as primary because the structure of the cambium and residual meristem cells which give rise to the smaller vascular bundles is different. Though it should be noted that the residual meristem shows cambium-like behaviour and the primary vascular tissues formed from it are also arranged in a radial manner. But these features are not always a sound criterion for delimiting secondary from primary tissues (Esau[3]). Therefore the later-formed smaller vascular bundles can be said to be formed by delayed or prolonged primary growth.

I am grateful to Prof. Maheshwari for suggesting the problem and kind interest.

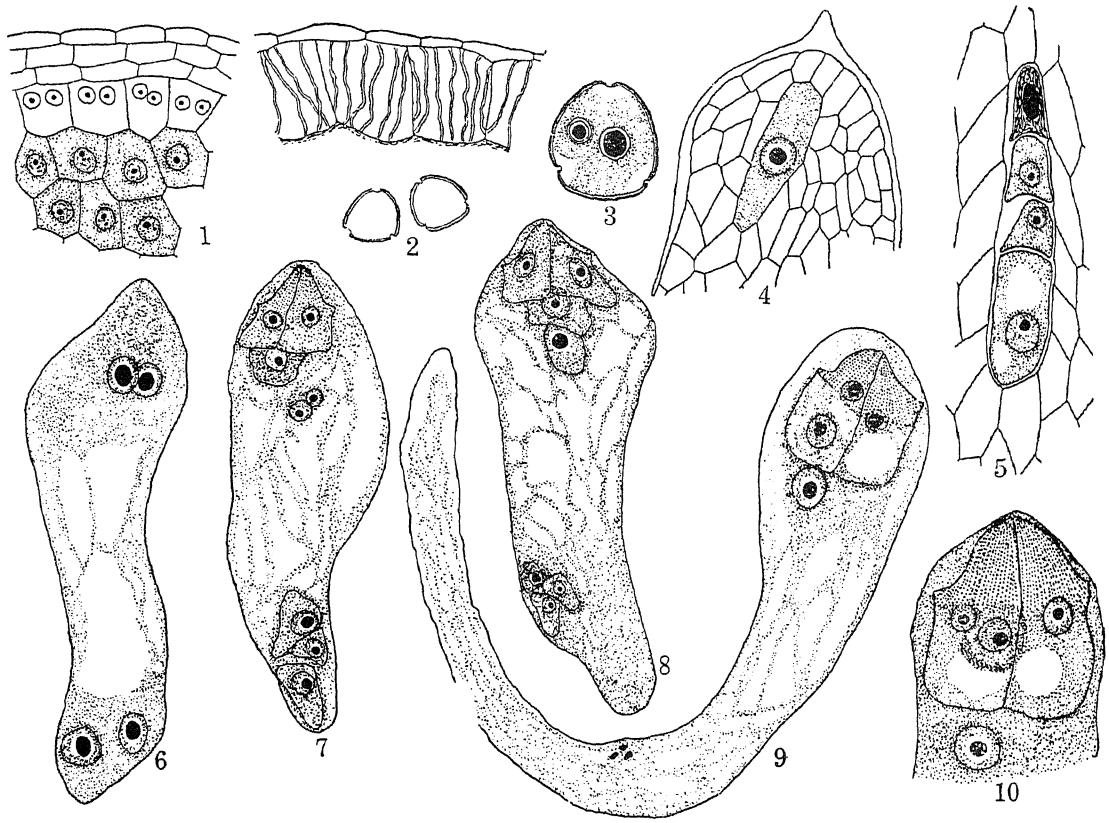
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A CONTRIBUTION TO THE EMBRYOLOGY OF *OPILIA AMENTACEA* ROXB.

Opilia amentacea Roxb., belonging to the parasitic Opiliaceæ, displays certain interesting features in its mode of life, floral structure and reproduction showing similarities with the allied families of the order Santalales.

The floral parts arise in acropetal succession. The young anther wall is composed of three layers external to the tapetum (Fig. 1). The tapetal cells are binucleate and are of the glandular type. The endothecium develops fibrillar thickenings (Fig. 2). The microspore mother cells after undergoing meiotic divisions give rise to microspores which are arranged tetrahedrally. The tricolpate pollen grain is two-celled at the time of shedding (Fig. 3).



FIGS. 1—10

FIG. 1. Portion of anther lobe showing epidermis, endothecium, middle layer, binucleate tapetum and sporogenous cells, × 250. Fig. 2. Portion of anther wall showing fibrillar endothecium, × 250. Fig. 3. Mature pollen grain, × 500. Fig. 4. L. s. ovule showing archesporial cell, × 250. Fig. 5. Linear tetrad of megaspores, × 375. Fig. 6. Four-nucleate embryo sac, × 375. Fig. 7. Young embryo sac, × 250. Fig. 8. Lower end of the embryo sac elongating leaving the antipodals *in situ*, × 250. Fig. 9. Mature embryo sac, × 250. Fig. 10. Egg apparatus showing filiform apparatus in synergids, × 375.

The ovary is unilocular, superior and is surrounded by a hypogynous disc which has five prominent fleshy club-shaped glands. As in Santalaceæ the gynœcium in this member conforms to the paracarpous type. A mound of tissue arises from the base of the ovary to form the mamelon, which, as development proceeds, produces a downward facing ovule projecting into the ovarian cavity. While generally a single ovule develops, occasionally two pendulous ovules are seen projecting into the ovary cavity on either side of the mamelon. The ovules do not show any differentiation into nucellus and integument. There is, therefore, nothing which can be designated as the micropyle. However, the side towards which the megaspore mother cell differentiates is considered micropylar, while the term *chalazal* is used in the same sense as basal.

A single hypodermal archesporial initial (Fig. 4) gives rise to a deep-seated megaspore mother cell which undergoes the usual meiotic divisions to form a linear tetrad of megaspores (Fig. 5). The chalazal megaspore develops further, while the other three degenerate. The development of the female gametophyte conforms to the Polygonum type (Figs. 5-7). The morphological upper end of the embryo sac enlarges while the lower end narrows and elongates. The eight-nucleate embryo sac is oval, and remains intraovular for some time but subsequently the lower end of the embryo sac begins to grow further leaving the antipodal cells *in situ* (Fig. 8). Then it takes a bend and grows down making its way through the central column and developing into a prominent haustorium (Fig. 9). Thus the embryo sac in its fully grown condition assumes an

inverted U shape bearing a very close resemblance to that seen in *Thesium wightianum* (Rao[1]). The synergids are slightly hooked and exhibit filiform apparatus. The egg hangs down below the synergids. The secondary nucleus becomes associated close to the egg (Fig. 10).

My grateful thanks are due to Profs. L. N. Rao and C. V. Krishna Iyengar for their valuable help.

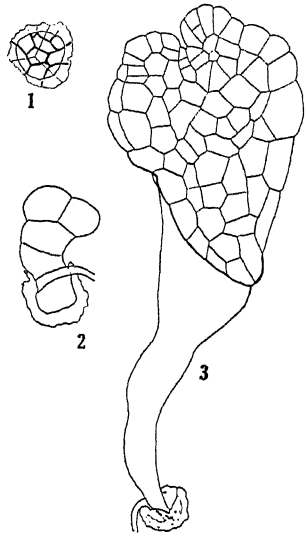
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Central College, Bangalore,
March 7, 1955.

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SPORELING GERMINATION STUDIES IN *CRYPTOMITRIUM HIMALAYENSIS* KASH.

Cryptomitrium himalayensis Kash. is monœcious with thalli yellowish green, delicate; antheridia borne in the mid-dorsal groove just behind the stalk of the female receptacle; and met with in the moist, often dark places in caves, in North-Western Himalayas at an altitude of 5,000-7,000′. The ripe spores were collected on September 28, 1948, and during September 1949 from Mussoorie and germinated as on a previous occasion.[1]

The spores are spherical, light brown, with a triradiate mark, reticulate exine (2-4 reticulations in a diameter), with a perisporium (Fig. 1) and 50-75 μ in diameter. They germinate readily within a week and rupture at the triradiate mark to liberate the germ papilla which has already developed chloroplasts and a few oil globules. The germ cell undergoes a lateral or basal transverse division and the cell thus formed elongates to form the first rhizoid which is thus separated from the mother cell by a definite wall. The rhizoid, sometimes late in development usually contains a few degenerating chloroplasts. The germ tube formation is a common feature. Rarely 3 germ tubes may be formed from a germ cell as in *Plagiochasma*,[1] *Targionia* and *Athalamia*.



FIGS. 1–3. Some stages in germination of *Cryptomitrium himalayensis*.

The growth, development and behaviour of the germ tube resembles that of other Rebouliaceæ[1] but the early stages are variable. Formation of a vertical wall in the terminal cell (Fig. 2) initiates disc formation, either immediately or after elongation of the germ tube. The latter is caused by unfavourable illumination.

The germ disc when mature is more or less inclined at an angle 30-40° on the germ tube axis. The elongated germ disc becomes two-layered even at a younger stage. It grows for some time by the apical marginal meristem, later replaced by a tetrahedral apical cell, lodged within the apical notch. In this disc later the apical region, due to more layer formation, becomes prominent and slightly raised up from the surface of the basal region of the sporeling (Fig. 3). This demarcation becomes prominent due to the development of anthocyanin pigment in some of the marginal cells of the thallus (and also in the basal cells of this ascending region). Gradually the basal region decays at the expense of the apical region which directly passes into the main thallus, thus greatly reducing the time from germination to thallus development. The effects of weak illumination and excessive moisture are same as described for other Rebouliaceæ.

It is thus evident that in Rebouliaceæ the formation of germ disc is either of *Reboulia* type or of *Asterella* type. The development in *Cryptomitrium* is more or less inclined towards the *Asterella* plan.

I am grateful to Profs. P. N. Mehtra and W. C. Steere for encouragement.

Malaria Res. Lab., P. KACHROO.
D. V. C., Burdwan,
December 28, 1954.

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AN UNDESCRIBED SPECIES OF *PROTOMYCOPSIS* ON *CROTALARIA TRIQUETRA* DALZ.

ON leaves of *Crotalaria triquetra* Dalz., black spotting incited by a species of *Protomycopsis* was noticed near Mount Abu in September 1953. The spots were mostly confined to the lower leaves, first appearing as light yellow specks, gradually enlarging and turning black. On mature leaves the spots were 2-7 mm. in diameter, often coalescing to form larger patches.

Microscopic examination of the infection spots revealed the presence of intercellular hyphæ and numerous dark reddish brown resting spores densely interspersed in the intercellular spaces. Mature spores measure 16-24 μ in diameter with mean of 19 μ, and possess thick warty wall characteristic of the genus *Protomycopsis*.

Comparative studies have indicated that the species under study is undescribed, and comes close to *Protomycopsis patelii* Pavgi. and Thirumal recorded from India on *Phaseolus radiatus* L.[1] The latter species has larger resting spores (22·5-32·5 μ as compared with 16-26 μ) than the fungus under study. The name *Protomycopsis crotalariæ* is proposed for its accommodation.

Protomycopsis crotalariæ Joshi Sp. Nov. infection spots circular, 2-7 mm. in diameter, black, often coalescent with each other. Resting spores embedded in mesophyll, aggregated in groups, dark reddish brown, 16-26 μ in diameter with a mean of 19 μ, irregularly globoid, thick-walled, rugose (Fig. 1).

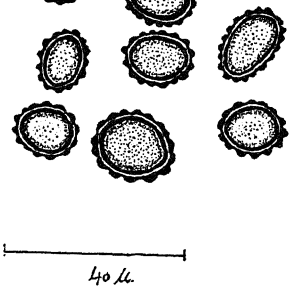


FIG. 1

Maculæ circulares, 2-7 mm. in diameter, nigræ, sæpe confluentes. Sporæ quiscentes in mesophyllo evolutæ, *plus* minusve aggregatæ, irregulariter globosæ, atro-brunneæ, 16-26 μ in diameter in medio 19 μ episporio crassiusculo, rugoso.

Hab. in foliis vivis *Crotalariæ triquetræ* Dalz. Mount Abu, Sept. 1953, leg. N. C. Joshi (Type) deposited in Herb. Crypt. Ind. Orient. New Delhi, and Herb. C.M.I., Kew, England.

I am grateful to Dr. M. J. Thirumalachar for his invaluable help in the identification of the fungus, to Mr. M. B. Raizada of F.R.I., Dehra Dun, for the identification of the plant, and to Prof. B. Tiagi and Principal V. V. John for encouragement.

Dept. of Botany, N. C. JOSHI.
Govt. College, Ajmer,
January 22, 1955.

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MALFORMATION DISEASE OF MANGO (*MANGIFERA INDICA* LINN.)

A MALFORMATION disease of mango shoots, particularly of the inflorescence has recently become very serious.[1-4]

The cause of the disease has not been traced so far. Sattar[5] considers it to be a malady either of a virus or of a physiological nature. According to Sharma[6] it is neither of fungoid, bacterial nor virus origin. Tripathi[7] observed that malformation diseases of vegetative shoots and inflorescences are highly correlated and appear to be one and the same. Recently, Narasimhan[8] found a species of *Eriophyes* causing malformation in mango inflorescences only.

The present author has, however, observed two more species of mites *Tyrophagus castellanii* Hirst (Acaridæ) and *Typhlodromus* sp. probably *asiaticus* Evans (Phytoseiidæ) causing the malformation of mango inflorescences as well as that of vegetative shoots. The first species is commonly known as 'Copra itch mite' which feeds on stored food products, probably feeding on fungus growths and decomposing vegetable matter, while the other may feed on fungus or may be predatory on the first.

The mites are present on the affected trees in large numbers from July to October. During middle of September they can be seen with a magnifying glass crawling on otherwise healthy leaves. During the period July to October, every stage of development of the mites can be obtained from the affected shoots. When winter sets in, they hibernate under the folds of the dried scales and again become active from February to April of the year following. During May-June they take shelter under the dried malformed inflorescences and bunchy shoots. Eggs and larvæ may also be obtained during these periods on young trees which bear off-season inflorescences. After October,

mostly the larvæ are obtained from the malformed vegetative shoots of the tree, whereas the adults are rarely observed. During November-December, most of the young saplings raised for stocks make new growth. These may be affected by the mites.

The full-grown mites are 0·3 mm. in length. Eggs are laid singly under the folds of dried scales and are protected with a webby material by means of which they stick to the scales. The size of an egg is 0·1 mm. and it is typically oval and pearly white. During the warmer season they hatch out in 2-3 days and the nymphs crawl all over the affected shoots. Adult mites are white to pale white in colour.

Application of sulphur dust against the malformation of mango inflorescences did not check the disease. Affected shoots were pruned and 2% tar oil wash (ovicide of I.C.I.) was sprayed on these trees, but did not prove effective.

The author expresses his grateful thanks to Dr. L. B. Singh, for providing facilities for this work and to the Director, Commonwealth Institute of Entomology. London, for identifying the mites.

Govt. Fruit Res. Station, S. M. Singh.
Saharanpur, *January* 7, 1955.

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OCCURRENCE OF DOUBLE FLOWERS AND POLYCARPY IN THE GENUS CICER LINN.

At Government Research Farm, Kanpur, four strains of gram are characterised by having double flowers on one peduncle. These strains are No. 159, NP 82, No. 188 and No. 333, strains 159, 188 and 333 being hybrid selection from crosses where one parent was NP 82 (a double flowered strain itself). As a rule there is one axillary flower in the axil of a leaf on one pedicel. In these double-flowered strains, paired peduncles, each with one flower, appear on one pedicel in the very axil. In rare cases, in these double-flowered strains, as an abnormality three flowers in the aforesaid fashion are borne in one axil.

One flower of the double-flowered pedicel, and generally the younger one, is abnormal. Accessory and essential floral parts in these abnormal flowers are often in excess to the general number of these parts. Sepals are from 5-9, petals from 5-7, stamens from 10-17, and carpels from 1-5.

Petals expose the sexual organs of the flowers very early, as soon as they come out of the calyx tube. The more striking phenomenon is sepaloidy of the petals and transformation of essential floral parts into branched shoots in some cases.

Stamens in these flowers are always in polyadelphous condition and very often epipetalous stamens are met with.

Carpels exhibit various interesting forms which may be enumerated as below:

(*i*) Monocarpellary ovary: (*a*) stigma single terminal; (*b*) stigma bifid. (*ii*) (*a*) Bicarpellary apocarpous; (*b*) bicarpellary, both the carpels fused at the base but free above. (*iii*) Tricarpellary ovary: (*a*) two carpels as in (*ii*) (*b*) and one alone; (*b*) all the three separate. (*iv*) Tetracarpellary ovary: (*a*) 4 separate carpels; (*b*) 4 forming two pairs and each pair representing the condition as in (*ii*) (*b*); (*c*) 3 having single stigma but the fourth one having bifid stigma. (*v*) Pentacarpellary apocarpous ovary. (*vi*) Sometimes pedicels of two or more flowers fuse together and give the flower an appearance of polycarpy. Here the inflorescence looks like a corymb.

It is an interesting case of polycarpy in the genus Cicer. It suggests and supports the theory that highly evolved forms of Rosales represent reduction in the number of carpels and attainment of zygomorphy. The presence of multicarpellary ovaries, conversion of floral parts into stamens and polyadelphous condition of stamens are cases of 'reversion' in the genus. More than one carpel have been observed in the other subfamily Cæsalpiniody, *Poinciana regia* Boj. (Joshi[1]).

In these double-flowered strains which have one flower of the pair abnormal, grain-setting studies were made. It was observed that the abnormal flower of the pedicel does not set pod invariably.

In exceptional cases where the pedicel bears two or sometimes even three normal flowers setting in all the two or three flowers (as the case may be) takes place and double or triple pods in the axil are seen accordingly.

Examination of the pollen grains in these abnormal flowers reveals that 90-95% of the pollen are viable as judged by acetocarmine stain method.

Govt. Res. Farm, Kanpur, *January* 31, 1955. S. P. SINGH. T. R. MEHTA.

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PHOTOPERIODIC RESPONSE IN TIL (*SESAMUM INDICUM* LINN.)

THE effect of short photoperiods on the acceleration of flowering in different varieties of sesamum has been reported previously.[1-3] The present note reports the effect of short photoperiods of varying durations on seedlings of two pure strains of *deshi* til, *Jinardi* and *Goghat*, early and medium-late, having black and brown seed respectively. Seeds of *Goghat* and *Jinardi* were sown in earthenware pots (12" × 11") on March 10 and May 1, 1950 respectively with three replicates for each treatment. After ten days of sowing, the pots were thinned, keeping only the best four uniform plants in each treatment, and then short photoperiods of 7 and 9 hours for 4, 5 and 6 weeks' duration were applied. The seedlings receiving short photoperiods of 7 and 9 hours were exposed to the sun from 7 a.m. to 2 p.m. and 4 p.m. respectively, and for the rest of the day and night they were kept in a well-ventilated dark room. The control seedlings of each variety were left to grow all through their life-period in the natural day length. The results of the experiment presented in Table I are found to be significant at 1% level, except the number of capsules in *Goghat* which is not statistically significant.

TABLE I

Variety	Treatment*	Days from sowing to flowering	Number of leaf pairs at first flowering time	Height in cm. at flowering time	Number of branches	Number of capsules
JINARDI ..	A	40·7	9·9	51·3	9·2	14·6
	B	34·5	7·1	37·4	5·2	12·7
	C	34·0	7·1	39·7	5·4	11·0
	D	30·4	7·1	34·9	7·4	20·5
C.D. at 5% level		1·69	0·23	5·6	1·98	3·83
GOGHAT ..	A	63·9	11·1	43·0	11·4	26·5
	B	39·2	4·9	15·8	6·4	38·8
	C	39·2	4·4	15·1	6·0	44·8
	D	40·7	5·7	15·2	6·9	40·2
C.D. at 5% level		9·11	1·5	5·3	2·12	21·62

* A—control ; B—7-hour day for 4 weeks ; C—7-hour day for 5 weeks ; D—9-hour day for 6 weeks.

The results show that the short photoperiods induce acceleration of flowering of the main shoot as well as the branches indicating that the whole plant is affected by the treatment. With acceleration of flowering by short days there occurs a reduction in vegetative growth as indicated by the plant height, number of branches and leaf number. Marked decrease in vegetative growth is noticed in the medium-late variety, *Goghat*, where the effect of short photoperiods is more pronounced than in the early variety, *Jinardi*. Like paddy,[4] in sesamum also there exists positive and significant correlation between leaf number and the time of flower formation. Analyses of co-variance of both the varieties were calculated, and it was found that there was a good correlation between the leaf number and the days of flowering from sowing.

It is interesting to note that the shape and size of the leaves of both the varieties have been changed by short photoperiods. The leaves of the control plants are much bigger with middle leaves serrated and lobed trifoliately, while those of the treated ones are entire showing no trifoliate nature. Sen Gupta and Payne[5] have reported that short photoperiods have very little effect on leaf shape, while long photoperiods and different sowing times cause different shapes of leaves with serration and various degrees of split margins in two varieties of sesamum, I.P.-29 and I.P.-7, marked variation being noticed in I.P.-29 when treated with long photoperiods. Regarding the number of capsules, short days increase the number in both the varieties.

State Agric. Res. Station, Chinsurah, Hooghly, *January* 6, 1955. B. N. GHOSH.

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LINKAGE OF "PALE GREEN LEAF" WITH "CURLED LEAF" IN *G. HERBACEUM*

GENETIC investigations of the Curled Leaf Mutant[1] are in progress at the Agricultural Research Station, Surat. This mutant gene appears to be identical with that for Curly Leaf reported by Yu[4] as is indicated by its 17% recombination with the gene for leaf shape. The cross effected between Curled Leaf

TABLE I

	Normal		Curled		Total	χ^2		χ^2/L	P
	Green Leaf	Pale Green Leaf	Green Leaf	Pale Green Leaf		Normal/ Curled	Green/ Pale Green Leaf		
A* ..	153	69	72	6	300	0·16	..	..	0·5–0·7
						..	0·00	..	Very high
						..	..	17·28	< ·001
B* ..	197	92	98	3	390	0·17	..	..	0·5–0·7
						..	0·09	..	0·7–0·8
						..		34·11	< 0·001
					Total	0·33	0·09	51·39	..
Total ..	350	161	170	9	690	0·33	..	..	0·5–0·7
						..	0·05	..	0·8–0·9
						..	..	50·86	< 0·001
	χ^2 for homogeneity					Nil	..	..	> 0·99
						..	0·04	..	0·8–0·9
						..	..	0·53	0·3–0·5

* A—Cross-Pale Green Leaf × 2087 Curled; B— Cross-Pale Green Leaf × 1027 Curled.

found in both 2087 and 1027-A.L.F. varieties and the Pale Green Leaf Mutant[3] has revealed that the genes governing the two mutant characters are located on the same chromosome. The F_1 was normal, green. The F_2 segregation was as in Table I.

The R.P. determined by the maximum likelihood method is 22·5. With the discovery of this relationship, the gene for the Pale Green Leaf is included in the linkage group, consisting of the genes for (1) leaf shape, (2) lint colour, (3) curled leaf, and (4) lintless (lid). The position of Curled Leaf and Pale Green Leaf in relation to the other three genes, however, remains to be determined.

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SOMATIC CHROMOSOMES OF *ANTHERICUM VARIEGATUM* HORT. EX FL.

Anthericum variegatum Hort. ex. Fl. is an introduced plant, native of Europe, America, tropical and subtropical Africa. It is a rhizomatous plant, propagated by division from offsets.

A number of metaphase figures were observed in the roots of *Anthericum variegatum*, Hort. ex. Fl., while studying the ontogeny of velamen. The basic numbers of the genus are known to be 7 and 8. The species in which chromosome number is known so far[1] are as given in Table I.

TABLE I

Name of the species	Chromosome number ($2n$)	Locality
Anthericum ciliatum	14	Venezuela
A. roscum	32	..
A. ramosum	32	Europe
A. liliago	64	Europe and North Africa

The chromosome number of *A. variegatum* is being recorded for the first time. A number of metaphase polar view drawings showed that the chromosomes are 24 ($2n$) (Fig. 1). The chromosomes can be roughly arranged in 12 pairs (Fig. 2). One pair is dissimilar. Three pairs have submedian fibre-attachment constrictions, five pairs may be roughly described as having subterminal fibre arrangement constriction and three pairs median fibre attachment constriction. The number 24 ($2n$) tallies with the basic number 8 and it seems this species is a triploid.

Further work is in progress and will be published elsewhere.



×950

FIG. 1

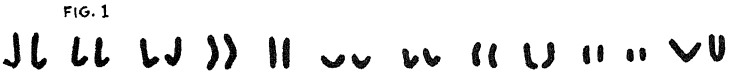


FIG. 2

My sincere thanks are due to Dr. B. N. Mulay, for his encouragement and guidance.

Dept. of Botany, B. D. DESHPANDE.
Birla College of Science, Pilani,
November 20, 1954.

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STRUCTURE AND DEVELOPMENT OF NUTMEG SEED

VOIGT[1] observed in 1888 that the ruminate endosperm in *Myristica fragrans* is formed by the infoldings of the inner integument. Since then no detailed study of the structure of the nutmeg seed has been made. With a view to elucidating the structure of the seed of *Myristica fragrans* Von. Houtt. or nutmeg, a detailed study of the structure and development of the ovule and seed of nutmeg was taken up and the results obtained are briefly recorded in this note.

The ovule is anatropous, bitegmic and crassinucellate. The micropyle is formed by the inner integument alone, which grows beyond the outer (Fig. 1). It is closely appressed to the latter on one side and to the nucellus on the other, but all the three structures remain distinct from each other right up to the chalaza. In older ovules, however, the line of demarcation between the nucellus and the inner integument becomes difficult to distinguish especially in the chalazal region, and this may even lead to the erroneous idea that the lower part of the ovule is formed by the upward extension of the chalaza. In young seeds the two integuments are wide apart from one another in the micropylar region, leaving a space in between (Fig. 2). Each integument is 4 or 5 layers in thickness (Fig. 1). The embryo sac is formed according to the Polygonum type of development. It becomes elongated in form and crushes the nucellus except for about 4 layers at the micropylar end. A postament is formed at the antipodal end. Even before fertilization the outer integument begins to proliferate at the micropylar region and eventually forms the aril (Fig. 2) which envelops the mature seed as a third integument.

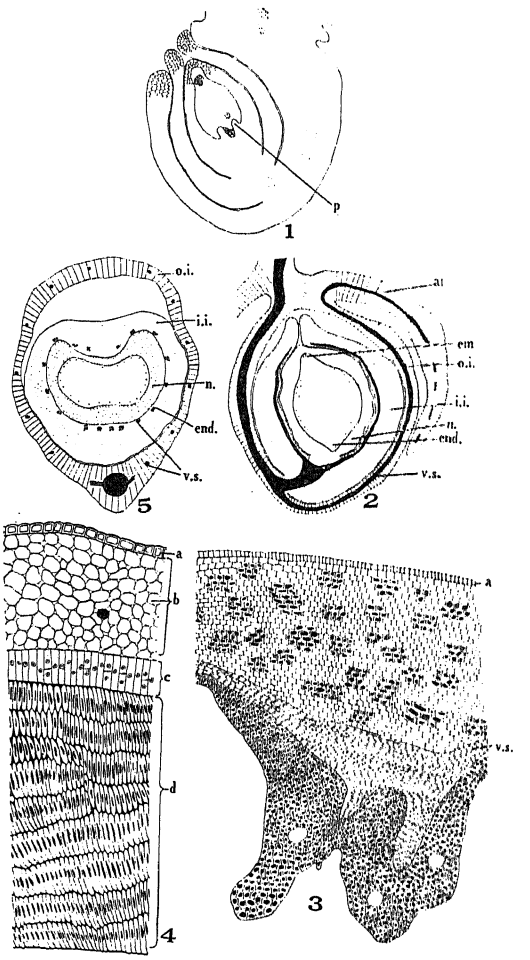


FIG. 1. *l.s.*, ovule showing mature embryo sac and postament (× 30). FIG. 2. *l.s.*, seed at about the time the infoldings of the inner integument begin to appear, showing course of vascular bundles in the integuments and aril (× 8). FIG. 3. *l.s.*, inner integument after the infoldings are formed (× 30). FIG. 4. *l.s.*, outer seed-coat of mature seed (× 30). FIG. 5. *t.s.*, seed at about the same stage as in Fig. 2 showing arrangement of vascular bundles in the integuments (× 12). *a*–epidermis; *b*–zone of parenchymatous cells; *c*–row of radially elongated cells; *d*–fibrous cells, *ar.*–aril, *p.*–postament, *o.i.*–outer integument; *i.i.*–inner integument; *n.*–nucellus; *end.*–endosperm; *em.*–embryo, *v.s.*–vascular strand.

Fertilization is porogamous. The pollen tube persists in the seed till a young embryo is formed. The endosperm is of the nuclear type. It becomes cellular in older stages of seed development. In the mature seed the endosperm completely replaces the nucellus. The zygote divides soon after fertilization and embryo development proceeds rapidly. The growth of the embryo in size is not in keeping with that of the seed. The mature dicotyledonous embryo which is very small, is imbedded in the massive endosperm.

As the seed enlarges, the inner integument grows in thickness and becomes many-layered. Even before cell-wall formation starts in the endosperm, the inner integument gives out infoldings from the sides into the nucellus. The cells of the inner integument are thin-walled and are filled with tannin (Fig. 3). It remains much the same in structure and thickness, and forms the inner seed-coat of the mature seed. The outer integument does not grow much in thickness till the seed is nearly mature. Its outer epidermis shows stomata. The cells of its inner epidermis have dense cytoplasm and prominent nuclei. They become radially elongated and look like palisade cells. As the seed reaches maturity, these cells, by repeated transverse divisions, give rise to 8-10 layers of radially elongated cells whose walls become sclerified and show simple pits. In the mature seed which is 1½-2″ in length, the outer seed-coat, formed by the outer integument, is very hard and thick and consists of (Fig. 4), (1) the epidermis with cuticularised thick-walled cells, (2) a zone of 5-6 layers of parenchymatous cells, (3) a row of radially elongated cells with dense cytoplasm and nuclei, and (4) 6-8 layers of fibrous cells.

The ovular vascular bundle splits up into a number of strands which form a ring of bundles in the chalaza about the time the infoldings of the inner integument begin to appear. Some of these pass into the outer integument in which they reach up to the micropyle and thence into the aril (Fig. 2). The other vascular strands pass into the inner integument (Fig. 5) and traverse upto the micropyle (Fig. 2) giving out on their way a branch to each of the infoldings (Fig. 3). The presence of vascular bundles in the inner integument has been recently reported in *Ricinus communis* by Singh.[2]

The author is indebted to Prof. J. Venkateswarlu for suggesting the problem and for his helpful guidance and to Mr. K. Fazlullah Khan and Mr. J. Samuel Sundara Raj, Coonoor, for supplying fixed material.

Dept. of Botany, R. L. N. Sastri.
Andhra University,
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RATES OF INITIATION IN THE POLYMERISATION OF METHYL ACRYLATE

Only a few investigations[1-6] have been reported so far with regard to the mechanism of free radical polymerisation of methyl acrylate in liquid phase. Matheson *et al.* have evaluated the absolute rate constants for propagation, termination, etc. Nathan Fuhrman *et al.*[7] and Jyothindranath Sen *et al.*[8] have reported the values for the constants in the Staudinger equation, for the average degree of polymerisation for polymethyl acrylate. We are reporting here the general nature of polymerisation of methyl acrylate under various conditions and evaluation of rates of initiation (R_i') and chain transfer constants for the monomer (C_M) and catalyst (C) benzoyl peroxide. The polymerisation experiments were confined to a temperature range of 55-70° C. The results indicate the almost unitary nature of the catalyst efficiency, first order kinetics of the overall rate, bimolecular nature of the termination process, the order of initiation rates and chain lengths, the transfer of the growing polymer chain with the catalyst and the monomer.

Rate of initiation has been deduced from the product of square of the slope (KM) of the plot (Fig. 1, A, B, C and D), overall rate against square root catalyst concentration and the slope ($A'/M^2 = A$) of the plot, (Fig. 1, A, B, C and D) reciprocal degree of polymerisation against overall rate. Further from the slope and intercept of the plot ($1/P_n - AR_p$) against [Cat]/[M], (Fig. 2, E), the constants C_C and C_M have been evaluated. A and K are constants involving rate constants for termination and propagation.

It was found that carefully deaerated pure methyl acrylate monomer at 50-70° C. without any initiator gave often irreproducible results with induction periods for over 4 hours. Experiments in ethyl acetate solution did not eliminate the induction periods. With benzoyl peroxide (10^{-3}-10^{-4} M) however pure methyl

acrylate gave rather high initial rates and an irregular variation of overall rate with

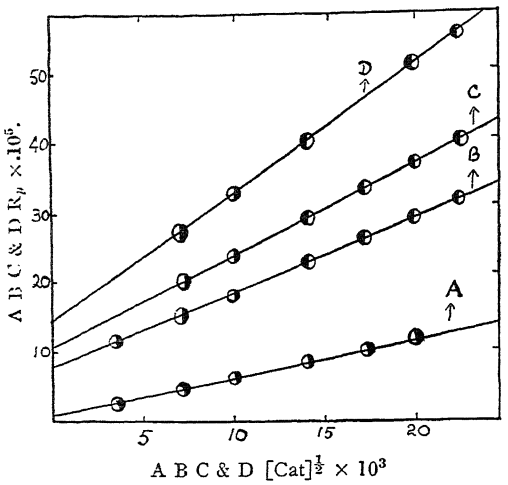
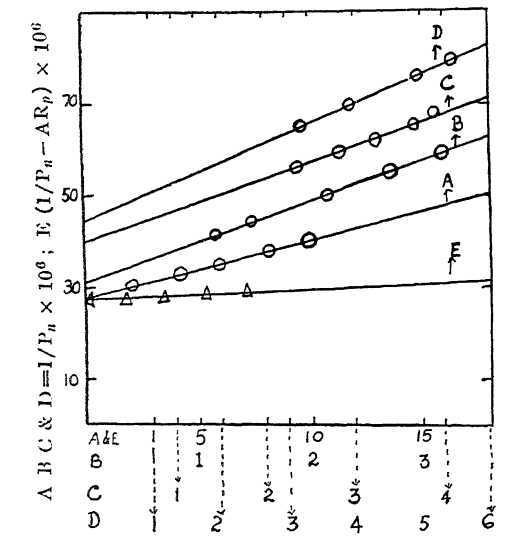


FIG. 1. Plot A represents the relationship between overall rate and square root catalyst concentration, in the polymerisation of methyl acrylate (50% solution in ethyl acetate) at 55°C., the time of the reaction being an hour and a half. Plots B, C and D represent similar relationships at 60°, 65° and 70° C., respectively.



$A = R_p \times 10^5$; B C & D $= R_p \times 10^4$; E $= [(Cat)/M] \times 10^5$

FIG. 2. Plot A represents the relationship between reciprocal degree of polymerisation and overall rate in the polymerisation of methyl acrylate (50% Solution in ethyl acetate) at 55° C.

Plots B, C and D represent similar relationships at 60°, 65° and 70° C.

Plot E represents the relationship between $(1/P_n - AR_p)$ and [Cat]/[M] at 55° C. in the polymerisation of methyl acrylate (50% solution in ethyl acetate).

(*a*) $[Cat]^{\frac{1}{2}}$, (*b*) reciprocal degree of polymerisation, though for the latter a regular variation was noticed if the initial rate was not very high. Ethyl acetate solution of methyl acrylate (50%) with benzoyl peroxide at 55-70° C. while eliminating induction periods gave also somewhat high initial rates. However, the first order kinetics for conversion of monomer has been observed.

At 55°, 60°, 66° and 70° C., the values obtained for K were $1{\cdot}038 \times 10^{-3}$, $1{\cdot}963 \times 10^{-3}$, $2{\cdot}327 \times 10^{-3}$, $3{\cdot}472 \times 10^{-3}$ respectively and for A' the values were 3·68, 2·5, 2·14, 1·97 respectively. Values for rates of initiation were $7{\cdot}94 \times 10^{-6}$, $1{\cdot}94 \times 10^{-5}$, $2{\cdot}32 \times 01^{-5}$ and $4{\cdot}8 \times 10^{-5}$ respectively. The transfer constants for catalyst was of the order of 10^{-2} and for the monomer, 10^{-6}.

A comparison of overall rates for thermal and catalysed reactions together with a knowledge of the catalysed initiation rates gave for the thermal rate constants for initiation the values, $9{\cdot}78 \times 10^{-12}$ at 60° C. and $2{\cdot}72 \times 10^{-11}$ at 70° C. Further the calculated values of chain lengths for polymethyl acrylate prepared under catalysed conditions at 55, 60, 65 and 70° C. were 36210, 37310, 39870 and 26040 respectively. The corresponding experimentally determined values for average degree of polymerisation were 23530, 17700, 15380 and 13160. The fact that P_n values are very much less than chain length suggests predominance of termination by combination.

Experimental results with a full discussion will appear elsewhere.

Univ. Physical Chem. Lab., Madras-25, *March* 16, 1955.

M. SANTHAPPA.
V. MAHADEVA IYER.

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REVIEWS

Electronic Measuring Instruments. By E. H. W. Banner. (Chapman & Hall), 1954. Pp. xiv + 395. Price 45 *sh.*

Electronic instruments nowadays find increasing applications in different fields of measurement, because they are more flexible for a given sensitivity. Further, another important advantage is the possibility of automatic control.

The book under review deals with various types of modern electronic instruments. The first part of the book discusses the indicating meters which record the readings ultimately on a panel. This is followed by a few chapters on what may be called the 'input' stage, like valves, photocells, radiations and particle detectors which convert the entity to be measured into electrical quantities. The third part deals with the complete set-up, like valve meters, cathode ray instruments, photoelectric devices and nuclear techniques such as radioactive assay instruments and the β thickness gauge. The last part of the book is devoted to electronic counters and quasi-electronic instruments like transducers and thermistors. A considerable portion of the book is contributed by specialists in the field like D. Taylor (radiation instruments), J. H. Reyner (cathode ray tubes) and the late R. C. Walker (photoelectric devices).

Granting the authors' choice of the instruments, one finds a lack of balance in the discussion of some topics. D.C. amplification, for instance, is treated at a very elementary level; contact potential is hardly indicated. Although this subject finds application in many instruments, the limits of sensitivity, as set by these factors, are not discussed. The section on cathode ray tubes and instruments may suffice only to understand the panel controls while under photo-electric devices, one finds, in some of the complete instruments, that the photocell is only a minor accessory, insignificant in comparison with the functions of the elaborate optical arrangement.

Minor blemishes are also found frequently. Particularly, one notices a lack of correspondence between symbols in text and those on diagrams. An extreme instance of this type is Fig. 9/1 where three of the four symbols are put wrongly. Again in Fig. 11/10 (*a*), the main amplifier is A.C. and not D.C. The circuit diagram of the triggered pulse generator (Fig. 2/8) is not correct. In the schematic diagram of counting system (Fig. 11/11) the high voltage may be more properly shown as applied to the detector rather than the preamplifier.

Modern electronics is not confined to the communication of signals as in the radio, television and radar. It has a much wider field of application, particularly in physical measurements. This book clearly indicates this growing trend and is a good general introduction to the subject.

K. S. CHANDRASEKARAN.

Automatic Protection of A.C. Circuits. Fourth Edition. By G. W. Stubbings. Revised and Edited by C. M. Dobson. (Chapman & Hall, London), Pp. 355. Price 50 *sh.*

In this fourth edition of the well-known publication, the chapters dealing with relays and protection systems have been completely revised and re-edited. The glossary of protective gear engineering terms has been re-edited. A new chapter dealing with the earthing of power systems neutral has been included. To enable students and engineers to appreciate present-day British practice in protective gear, information has been included regarding the selection and performance of protective gear normally provided on modern electrical equipments.

The first chapter deals with a historical survey of different steps in the development of automatic protective gear and discusses the advantages and limitations of the different systems. The next two chapters deal with the use of protective transformers, the different errors and their measurement, performance of current and potential transformers with special reference to the British Standards Specifications for such transformers. Detailed discussion is given of different methods of interconnection of transformers to obtain resultant currents or voltage corresponding to the vector addition or subtraction of the corresponding primary circuit currents or voltages. A general indication of the effect of errors of transformers on the results of the interconnection as also the effect of relay impedance on primary operating current are included.

A chapter is devoted to the theory of sym-

metrical components as a background to the understanding of classes of network in protective systems. Conditions which give rise to negative and zero sequence components are discussed and methods of calculations of fault currents are indicated. Various types of relays and their classification according to different characteristics are described in a chapter on protective relays.

The chapter on neutral earthing deals with the comparison of isolated neutral and solid earthing systems and discusses the different systems of earthing through impedance and their application to meet the different requirements in power systems. The next two chapters deal with modern methods of protection of electrical machinery, busbars, feeders and transmission line. The present-day needs of protection of unit-operated generators and transformers are fully discussed. The development of modern high speed protection and carrier current protection for long transmission lines are also included.

The last chapter is devoted to the testing and maintenance of protective gear. It is rightly pointed out that the testing of protective gear comprehends not only that of the instrument transformers and relays which are the component parts of the gear, but also the checking of the correctness of the assembly of these components and their connections to form a protective circuit.

The bibliography includes reference to the English publications in journals and books related to the subject. Some references to Continental and American publications would have been helpful.

C. S. Ghosh.

The Testing of High Speed Internal Combustion Engines. By Arthur W. Judge. (Chapman & Hall, Ltd., London), 1955. Pp. xvi + 494. Price 75 *sh.*

This well-known book has been published in its fourth edition which has been revised and enlarged considerably taking into account new measuring methods and instruments. It has thus become a text-book on the testing of Internal Combustion Engines covering this wide and varied field in its major aspects.

The text is divided into fourteen chapters, the first two covering the general principles, mainly of the Otto petrol engine and its performance, and the test procedure adopted for ascertaining its output. The next two chapters review the details of measuring techniques adopted for metering the charge, *i.e.*, for the fuel and the exhaust gases (Chapter III), and for the air supply (Chapter IV). The cooling water system of test set-ups is considered next. The central portion of the book is devoted to the measurement of the output (Chapter VI) which is followed by a detailed treatment of pressure measurements and the types of indicators used (Chapters VII and VIII), with two more chapters devoted to cathode ray indicators and a discussion on indicator diagrams and their evaluation. A chapter on temperature measurements concludes this more specific portion of the book, which is followed by three chapters outlining particular items involved in the testing of Diesel engines, reciprocating aero engines and mainly aero gas turbines. The book concludes with a chapter on some special instruments and measuring methods applied in more serious work, say, for research and development, and a number of appendices dealing with test data evaluation, the international standard atmosphere, the SAE aircraft engine test code, and finally the calculations of the air-flow passing through standard throttle plates. The index allows quick reference especially in combination with the detailed list of contents.

The book conveys excellently the present state of instrumentation and measuring techniques adopted in this important field of mechanical engineering with its often complex and unusual features such as high pressures and extremely high temperatures sustained only for fractions of a second, and high speeds and accelerations. Considering the extent of the subject, it is understandable that mention could be made only of the most outstanding contributions, but work undertaken on the Continent has found but little attention. A few further suggestions are: operational data are given for the petrol engine (Chapter I) but hardly for the Diesel engine, and Chapter II on test procedure contains subjects which are repeated later in greater detail. The new chapter on testing of complete gas turbines and their components and accessories is rather general, and the information contained in the last chapter could be inserted earlier where similar instruments are considered. Many readers may be interested to have more exhaustive information on standard test codes for stationary or of automotive engines rather than aero engine testing, and, incidentally, may also wish for more references (*e.g.*, on page 1) and information on suppliers (*e.g.*, page 229). Some small inaccuracies could be remedied in the next edition such as

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H. A. HAVEMANN.

idy of Madhya Pradesh Coals with Special Reference to Their Beneficiation and Caking Properties. By S. B. Pandya. (Published by he Nagpur University.) Pp. 108. Price Rs. 4.

While the contribution of Madhya Pradesh vards India's output of coal is just about , that State holds nearly 30% of our total il resources. The superiority of the coking ils obtainable from the collieries of Bihar d Bengal for metallurgical purposes has till w stood in the way of a proper exploitation Madhya Pradesh coal reserves. But with the ablishment of the new steel factory in the ate and with the further programme of dustrialisation envisaged in the Five-Year an, it may be expected that Madhya Pradesh il will come into its own in the near future. e publication of a monograph of this type M.P. coals is therefore meets a timely ed.

The earlier chapters in the monograph body the methods and results of systematic vestigation on a large variety of coal samples lected from different localities in the State. e proximate analysis of some 107 samples d the calorific values and sulphur contents over 50 of these samples are tabulated in is section. A scheme of grading of M.P. ils has been developed, which though based the scheme proposed by the Fuel Research stitute, is claimed to be more systematic. e best coals according to this grading—assified as 'Selected Grades A and B' and th price points in the range 75-81—come from e North Chattisgarh fields or Korba area. assification of coals has also been done on e basis of their 'rank' or maturity, accordg to Parr's classification and Specific Vola- e Index Classification Schemes. The later apters include determination of the caking dices of raw, beneficiated and blended sam- es, and washability tests by float-and-sink ethod using benzene-carbon tetrachloride ixtures. Conclusions have been drawn on e suitability of different coal samples for dustrial utilization such as the manufacture metallurgical coke, soft coke for domestic rposes, and of coke briquettes.

This useful and informative monograph will mmend itself to all engaged in coal research, and especially to those interested in developing Madhya Pradesh coal.

A. P. MADHAVAN NAIR.

Nutrition Research Laboratories—Annual Report for 1953-54. (Indian Council of Medical Research.) Pp. 27.

This booklet contains a report of the research work carried out at the Nutrition Research Laboratories, Coonoor, during 1953-54. As in previous reports, details of research work have been given of studies on vitamins, proteins, clinical investigations, pathology and field work, together with the titles of eighteen research papers published in India and abroad. It is stated that by the usual cooking procedures adopted in India, the losses in vitamin A varied between 10 and 47%, and not very much more as assumed by earlier workers. In regard to the mode of action of vitamin D, the conclusions drawn from the results so far obtained are interesting, but need confirmation, preferably by use of radioactive phosphorus and C^{14} labelled pyruvic and citric acids. A detailed study has also been made on body composition and basal metabolism, and the nutritional disease, "Kwashiorkar", has been further investigated. As regards studies on liver injury, the ideas put forward in lines 3 and 17 on p. 21 appear conflicting. In view of the recent reports on the biochemical importance of trace elements like molybdenum, parallel studies can profitably be carried out on some trace elements, particularly in experimental investigations of liver injury in rats. There is, however, no denying the fact that some very useful results have been obtained by the research group in Coonoor in both the fields of experimental and clinical nutrition, and one can look forward with confidence to more significant contributions in the future.

P. S. SARMA.

Semi-Micro Organic Preparations. By J. H. Wilkinson. (Oliver and Boyd, 98, Great Russel Street W. 1, London), Pp. x + 94. Price 8 *sh.* 6 *d.*

The above book describes a number of organic preparations involving the use of small-scale apparatus and semi-micro techniques. The advantages of the adoption of semi-micro techniques in preparative work are not so well recognised as in quantitative work, and the present work is meant to provide training in such techniques for beginners. The preparations included are varied in character and illustrate the different techniques employed.

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H. A. HAVEMANN.

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A. P. MADHAVAN NAIR.

Nutrition Research Laboratories—Annual Report for 1953-54. (Indian Council of Medical Research.) Pp. 27.

This booklet contains a report of the research work carried out at the Nutrition Research Laboratories, Coonoor, during 1953-54. As in previous reports, details of research work have been given of studies on vitamins, proteins, clinical investigations, pathology and field work, together with the titles of eighteen research papers published in India and abroad. It is stated that by the usual cooking procedures adopted in India, the losses in vitamin A varied between 10 and 47%, and not very much more as assumed by earlier workers. In regard to the mode of action of vitamin D, the conclusions drawn from the results so far obtained are interesting, but need confirmation, preferably by use of radioactive phosphorus and C^{14} labelled pyruvic and citric acids. A detailed study has also been made on body composition and basal metabolism, and the nutritional disease, "Kwashiorkar", has been further investigated. As regards studies on liver injury, the ideas put forward in lines 3 and 17 on p. 21 appear conflicting. In view of the recent reports on the biochemical importance of trace elements like molybdenum, parallel studies can profitably be carried out on some trace elements, particularly in experimental investigations of liver injury in rats. There is, however, no denying the fact that some very useful results have been obtained by the research group in Coonoor in both the fields of experimental and clinical nutrition, and one can look forward with confidence to more significant contributions in the future.

P. S. SARMA.

Semi-Micro Organic Preparations. By J. H. Wilkinson. (Oliver and Boyd, 98, Great Russel Street W. 1, London), Pp. x + 94. Price 8 *sh.* 6 *d.*

The above book describes a number of organic preparations involving the use of small-scale apparatus and semi-micro techniques. The advantages of the adoption of semi-micro techniques in preparative work are not so well recognised as in quantitative work, and the present work is meant to provide training in such techniques for beginners. The preparations included are varied in character and illustrate the different techniques employed.

A few errors are present which, it is hoped, will be eliminated in subsequent editions of the book. The inaccurate stoichiometric equation on p. 28 for oxidation of ethanol to acetic acid, the misleading statement on p. 82 that 'dimedone is.....a reagent for the preparation of aldehydes', and the description on p. 68 of the group NH-AC as acetylimino are errors which need to be corrected. Furthermore, a desirable improvement would be to state the standard yield obtained for each preparation, so that the student can evaluate his own technique.

These are only by the way, and the book will no doubt be found useful by students and teachers alike of preparative organic chemistry. S. SWAMINATHAN.

The Plant Quarantine Problem. By W. A. McCubbin. (Ejnar Munksgaard, Copenhagen.) Pp. 255. Price 34 *sh.* 6 *d.*

The author, who has a long experience of plant quarantine work in the U.S.A., has expounded in lucid style the principles and problems of plant quarantine. Although the literature of this subject is available from widely scattered sources, it is often concerned with particular phases of plant quarantine and no one has yet undertaken to present the subject as a composite whole, bringing together all its aspects in such a form as to constitute an overall review. The author in his present book has admirably succeeded in doing so.

The subject-matter of the book has been discussed in eight chapters: Introduction, The Biological Background, Social and Economic Relations, Legal Features, Administrative Aspect, Current Quarantine Problems Examined, Appraisal and Outlook and World Situation. There is an Appendix entitled 'The Historical Summary of Federal Plant Disease Quarantines'. The view-points presented in the book are mainly with reference to quarantine problems of the U.S.A., but the general considerations and conclusions would be of equal interest to other countries.

Plant quarantine is essentially a national undertaking and its effects are far-reaching on the agricultural economy of a country. Numerous examples of widespread destruction in the U.S.A. caused by introduced pests have been cited, much of which could have been prevented by timely action. There is a growing awareness in many countries of the benefits of plant quarantine. Although the book does not mention the efforts made towards international co-operation by the F.A.O. in 1951 in plant quarantine work and in the establishment of Regional Plant Protection Conventions, the publication of this book by Dr. McCubbin will doubtlessly stimulate wider interest in the subject. P. R. MEHTA.

Tissue Culture Technique in Pharmacology. By C. M. Pomerat and 49 other authors. *(Annals of the New York Academy of Sciences)*, Vol. 58, Art. 7, pp. 356. Price $ 4.50.

This symposium on "Tissue Culture Technique in Pharmacology" is of great interest not only to the pharmacologist but also to the virologist, the histopathologist and the clinician.

Tissue culture technique, an innovation introduced by Harrison in 1907, has opened up a fertile field for investigating the action of drugs on various types of cells (single cells, mass cultures, and organ cultures; normal and malignant cells, etc.), under varying conditions. Not only do we learn something new about drug action but of greater importance, we are given an inner glimpse of the function of subcellular structures in living cells. The value of tissue culture to the study of viruses and antibody formation is immense.

The utility of tissue culture technique in pharmacology, its advantages and limitations are revealed in this symposium. The effects of drugs on cell division, growth and intracellular morphological changes, metabolism and motility are studied yielding valuable information. The isolation, management, stability and use of strains of various normal and malignant cells are described, promoting better understanding of the biology of many diseases and growth processes at cellular level. The symposium is replete with data concerning the types of cells chosen for culture, culture media and their modifications, adaptation of apparatuses, etc., of immense value to the virologist and the cytologist. Adaptation of tissue culture technique for the production and assay of viruses and their antibodies is envisaged. A number of papers are devoted to the use of tissue culture technique for the screening of drugs as to their tissue toxicity, anti-neoplastic activity, cell-sensitivity, etc. The reasons for the failure of antibiotic therapy in certain infections are investigated by studying the actions of chemotherapeutic and antibiotic agents on intracellular bacteria. The symposium also contains a number of descriptive and elucidative photomicrographs and time-lapse phase-contrast cine-photomicrographs.

M. N. GURUSWAMI.

SPANISH WHEATS*

THIS is a most interesting book dealing with a difficult subject in a masterly way. The aim of the author may be gauged from a few paragraphs from the Introduction. "Wheat in Spain has always been the most widely cultivated plant and of the greatest economic importance. The varieties of Spanish wheat go into the hundreds as a result of the special geographical position of the Spanish Peninsula, of the many peoples that in the course of centuries have passed through it, of the isolation imposed on various agricultural zones by the complicated mountain chains. The Spanish Peninsula is therefore a veritable genetical treasure-house of incalculable value. Unfortunately in recent times there has started a gradual loss of native wheat forms, induced by such causes as the greater facility of communications, the interchange of seeds, the abundant seed distribution carried out by official bodies, etc....."

The author has spent years in collecting every possible type of wheat from every corner of Spain; his aim was not only to satisfy the curiosity of a botanist, but also to search for genetical material for the improvement of the wheat crops in the country.

The book consists of twelve chapters. Chapter I gives a very detailed description of all the parts of the wheat plant that are usually taken into consideration in the systematic classification of the genus. Chapter II gives an artificial key of all the species cultivated in Spain; the key is based on that of Flaksberger. Chapters III-X deal with the following species of wheat in Spain: *T. vulgare* Host., *Compactum* Host., *Durum* Desf., *Turgidum* L., *Polonicum* L., *Dicoccum* Schübl., *Monococcum* L., *Spelta* L.

To give an idea of the treatment of these various species, we may take Chapter III for detailed notice. It deals with *Triticum vulgare* Host. The author follows Vavilov in splitting the species into two groups, *ligulatum* and *eligulatum*; each of these groups is again divided into sub-groups: *Muticum* Alef., *Aristatum* Alef., *Breviaristatum* Alef. and *Inflatum* Flaks.; there then follows a key to the varieties under each of these sub-groups. From p. 39 onwards the author deals with the races of Spanish wheats under each of the varieties mentioned by Flaksberger. After an artificial key for the variety, the following points are given for each of the races: common local name, locality where the race grows, general characters, leaves, culms, ears, glumes, grain, field characters such as resistance to fungal pests, time from anthesis to ripening, short note on qualities for the preparation of bread.

Chapter XI is a summary of the details discussed in the previous eight chapters, giving the "geographical distribution of wheat varieties and races by regions and provinces"; it is a list where against the various provinces of the country are given the common or vernacular names and the equivalent scientific species and variety names.

Of the 80 plates in the book, two show the harvesting of wheat, and are of little interest; the rest show ears of wheat with some close-up photos to show details of the glumes, etc. Botanically the plates are very interesting and clear, and artistically they are a model of the photographer's art. The printing is neat and the whole book is a pleasure to the eye.

A few points on the negative side may also be mentioned. The scientific names are usually separated by a comma from those of the authors, a practice that is not recommended by the International Code of Botanical Nomenclature, though it was the general practice a few years ago. In the text occasionally specific names are capitalized (*e.g.*, on page 25), and the author's name is given in what appears to be Spanish (*e.g.*, on page 25, "*Triticum Polonicum*, Linneo"). In the Bibliography there are a few mispellings of foreign words. In a book of this sort, one would have expected greater attention paid to the genetical constitution of the species and varieties; the chromosome constituents of the various species are given on page 25, the chromosome number being the basis of the classification of wheat species, but there is no further mention in the book of the chromosome details of any of the varieties or races studied.

In spite of these slight blemishes the book is recommended as a model of typographic and scientific ingenuity; it is certainly an improvement on G. Evans "Varieties of Wheat grown in the Central Provinces and Berar" (1908), and on Howard and Khan "The Wheats of Bihar and Orissa" (1922).

Botanical Survey of India, Calcutta. H. SANTAPAU.

* *Trigos Espanoles (Spanish Wheats)*. By Manuel Gadea (in Spanish). Published by the National Institute for Agricultural Research, Madrid, 1954, pp. xv + 453, price not given.

NUTRITIONAL FACTORS AND LIVER DISEASES*

THIS symposium is an outstanding contribution to our knowledge and understanding of recent work on nutritional liver diseases. Experimental work in laboratory animals has established the conception that certain specific food materials are essential for the well-being of the liver parenchyma and that deficiency of these nutriments can produce damage to the liver as serious as any noxious substance. This has opened out new ground as yet unexplored in our interpretation and understanding of various obscure liver diseases which are now proved to be nutritional in origin. During recent years there has been a phenomenal increase of research in this direction in many laboratories especially in America and Europe and a remarkable array of facts has been brought to light. Time is ripe that these isolated pieces of knowledge should be put together into a complete picture and this is what the symposium has tried to do with conspicuous success. In a collection of carefully selected papers, it brings together the findings of various important workers in this field of scientific research scattered all over the world. An opportunity is thus afforded to compare and correlate the observations and conclusions of experimental work on laboratory animals with several obscure liver diseases prevalent in human beings especially in Asia and Africa.

Animal experiments have clearly shown that two distinct types of hepatic lesions are produced by deficient diets. In one case, there is a disturbance in the transport and utilisation of fat resulting in an intense fatty infiltration of the liver cells which, when long continued, develop a progressive diffuse fibrosis resembling Laennec's Cirrhosis. The other hepatic lesion brought about by deficient diet in experimental animals is massive necrosis, which either ends fatally or tends to heal with resultant scarring and nodular hyperplasia. Following these two separate disease entities of nutritional origin the symposium is divided into two main parts—one being devoted to fatty liver and cirrhotic diseases and the other to necrotic liver injuries.

Taking conditions in India, there is growing evidence to show that the fatty cirrhosis of the liver common in South India is a deficiency disease, closely similar in development to the pattern seen in experimental animals. But the specific type of cirrhosis seen in infants (infantile cirrhosis) common in several parts of India does not fit into any of the deficiency groups. Its cause and pathogenesis still remains vague and obscure.

This symposium is a valuable addition to our knowledge of liver diseases. It is bound to be of immense value to every worker in this field—clinician, pathologist or biochemist.

G. D. VELIATH.

* By Klaus Schwarz and 58 other Scientists. *Annals of the New York Academy of Sciences*, Volume 57, Art. 6, pages 615–962, Price $ 4.50.

DR. D. M. BOSE

DR. D. M. BOSE, Director, Bose Institute, was felicitated on the occasion of his seventieth birth anniversary by his admirers, colleagues, pupils and friends at an impressive ceremony held on March 6, 1955, at Bose Institute, Calcutta. Many distinguished citizens of Calcutta including educationists, scientists and others attended the function and messages from eminent scientists and men of public affairs from all parts of the country recalling the contribution of Dr. Bose to the progress of science in India and extending for nearly half a century, were read out.

Dr. H. C. Mookherjee, Governor of West Bengal, was the Chief Guest on the occasion and he along with Prof. M. N. Saha, Director, Institute of Nuclear Physics, and Prof. S. K. Mitra, Director, Institute of Radiophysics and Electronics, Calcutta, recounted the distinguished scientist's valuable contribution to the progress of science and scientific education in the country.

A special volume of the *Transactions of the Bose Research Institute*, containing a collection of papers contributed by 20 eminent scientists of India and abroad was dedicated to Dr. Bose on this occasion.

Books Received

The Nucleic Acids—Chemistry and Biology, Vol. I. By Erwin Chargaff and J. N. Davidson (Academic Press), 1955. Pp. xi + 692. Price $ 16.80.

Memoirs of the Society for Endocrinology. No. 3. The Technique and Significance of Oestrogen Determinations. Edited by P. Eckstein and S. Zuckerman. (Cambridge University Press), 1955. Pp. 96. Price 18 *sh.*

Molecular Vibrations—The Theory of Infra-Red and Raman Vibrational Spectra. By E. Bright Wilson Jr., J. C. Decius and Paul C. Cross. (McGraw-Hill), 1955. Pp. xi + 388. Price $ 8.50.

Theoretical Principles of Organic Chemistry, Vol. I. By Walter Huckel. (Elsevier Publishing Co.), Pp. xi + 904. Price 77 *sh.* 6 *d.*

X-Ray Diffraction by Polycrystalline Materials. Edited by H. S. Peiser, H. P. Rooksby and A. J. C. Wilson. (The Institute of Physics, London, S.W.-1), 1955. Pp. 725. Price 63 *sh.*

A Laboratory Manual of Qualitative Organic Analysis, Third Edition. By H. T. Openshaw. (Cambridge University Press), 1955. Pp. xii + 92. Price 10 *sh.* 6 *d.*

Modern Gas Analysis. By P. W. Mullen. (Interscience Publishers, Inc.), 1955. Pp. ix + 354. Price $ 5.50.

Higher Polymers—Emulsion Polymerization, Vol. IX. By Frank A. Bovey, I. M. Kolthoff, Avrom I. Medalia and Edward J. Meehan. (Interscience Publishers, Inc.), 1955. Pp. xii + 445. Price $ 12.50.

Methods of Biochemical Analysis, Vol. II. Edited by David Glick. (Interscience Publishers, Inc.), 1955. Pp. vi + 470. Price $ 9.50.

SCIENCE NOTES AND NEWS

New Laboratory Electromagnet

A new laboratory electromagnet embodying the most convenient features for varying magnetic field configurations was announced recently by Varian Associates, Palo Alto, Calif, manufacturers of klystron tubes and *n-m-r* spectrometers.

Varian's new magnet, the V-4004, has two fixed energizing coils with adjustable poles and readily changeable pole caps. A wide range of field contours can be set with ease. By a simple adjustment of each pole, any air-gap width up to 4·3" can be achieved. A variety of cylindrical, conical or specially-shaped pole caps are available for wide choice of flux patterns. Despite the comparatively small size of this new magnet, a gap field flux density as high as 28,600 gauss can be attained.

'Runaway' Nuclear Reactor

A nuclear reactor was deliberately allowed to get out of control recently at the United States Atomic Energy Commission's Reactor Research and Development Station in Idaho. All the safety control rods which maintain the "burning" of the atomic fuel were withdrawn so that the reactor could burn itself out.

The results proved far less disastrous than might have been expected, since after an initial period of "running away" in which rapidly increased fission and the generation of excessive quantities of heat occurred, the reaction slowed down and then stopped. The reactor had in fact proved self-controlling, the rapid increase in fission having created conditions under which the reaction necessary for the continued "burning" of the atomic fuel could not be maintained. It would appear that a large number of the nuclear reactors so far constructed are of the self-controlling type, but other types of reactors, such as those using fast neutrons which are capable of breeding more atomic fuel than they burn up do not come in this category.

Taste, Smell and Molecular Weight

In the course of an article on the above subject in *Chemical Products* (1955, 18, p. 131), R. W. Moncrieff has shown that there is a well-marked relationship between molecular weight and taste which is shown in the appearance of a bitter taste with increasing molecular weight, irrespective of whether the taste of lighter members of the series is sour, salt or sweet. Although not without exceptions, this rule is of very wide application indeed.

Very high molecular weights usually result in insolubility in water, and as a result in tastelessness.

There is not such a relation in the case of smell, no tendency for a particular quality of smell to develop with increasing molecular weight. Eventually, when molecular weight rises so high that volatility is lost, smell falls away too. Low molecular weight is accompanied by more rapid diffusion, which will enable a smell to be perceived more quickly. A preliminary investigation shows that substances that have musky smells have molecular weights that are fairly closely grouped. If adsorption of odorant on olfactory receptor is the process that initiates the sensation of smell, molecular weight might be a factor in olfactory discrimination.

Tetracycline

Tetracycline, also known as polycycline and bristacycline, has shown itself effective in eradicating the diverse bacteria responsible for acne and other troublesome types of skin disease.

According to Dr. Charles R. Rein and his co-workers, bristacycline brought forth a speedy response in all of a group of 106 patients, the majority of whom were suffering from common acne. In more than half the cases, the improvement was "moderate to marked" during the first week of treatment, and the new drug is well tolerated by patients. Adverse reactions appear to be less frequent and less severe than with previously employed broad spectrum antibiotics. The successful use of the drug for a variety of other infections was also reported before the Second Annual Symposium on Antibiotics recently held in Washington.

Treatment of Rheumatic Fever

The results of a remarkable international trial of the relative values of cortisone, "A.C.T.H.", and aspirin in the treatment of acute rheumatic fever in childhood are given in the March 5, 1955 issue of the *British Medical Journal*.

Essentially there was no difference between the effects of the three, which tends to confirm a previous report on the relative value of cortisone and aspirin in rheumatoid arthritis when, according to the criteria used, there was little to choose between them.

In the tests described six centres in the United Kingdom were used, five in the United States, and one in Canada. The criteria for diagnosis and for measuring progress were drawn up in great detail and nearly 500 patients under the age of 16 received the special treatment in the special way it was planned. The choice of drug was determined by the opening of a sealed envelope, so that there was no bias.

The hormone treatment (cortisone and "A.C.T.H.") appeared to produce more rapid control in certain acute manifestations, but this was offset by a greater tendency for relapses at the end of treatment. After a year there was no essential difference in the state of the heart in the three groups.

Post-Doctorate Fellowship Awards to Indian Scientists

The following Indian scientists have been awarded the National Research Council of Canada's Post-Doctorate Fellowships for 1955-56 :

J. Datta, Indian Institute of Science, Bangalore; I. Hussain, Muslim University, Aligarh; G. Kartha, University of Madras, Madras; M. L. Lakhanpal, Punjab University, Punjab; J. Sharma, Indian Institute of Technology, Kharagpur; G. Singh, N.P.L., New Delhi; A. G. Datta, Calcutta-19; M. L. Gattani, IARI, New Delhi; Rajindar Pal, Malaria Institute of India, Delhi; Vachaspati, Physical Research Laboratory, Ahmedabad; A. S. Atwal, Government Agricultural College, Ludhiana (Punjab).

Award of Research Degree

The University of Bombay has awarded the Ph.D. Degree in Chemistry to Shri G. Jagan Mohan for his thesis entitled "Biochemical Studies on the Flocculation of Sewage".

The University of Poona has awarded the Ph.D. Degree in Chemistry to Shri V. K. Phansalkar, for his thesis entitled "Dielectric Constant and Molecular Structure".

The Andhra University has awarded the D.Sc. Degree in Chemistry to Shri H. Sanke Gowda for his thesis entitled "Vanadametric Methods for the Assay of Pharmaceutical Preparations".

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ATOMIC POWER AND WORLD ECONOMY

PRIME MINISTER NEHRU has recently pointed out that underdeveloped countries like China and India cannot attain a high standard of living on the basis of coal and oil alone, and the only solution to this difficulty is provided by atomic energy. Even in highly industrialized Switzerland, the water power that has served so well and so cheaply is nearing the limit of its development and future power will be costly if it is based on imported coal transported over long distances. The only alternative is atomic power.

Thus, there are indications that a new era of power is beginning in almost every country in the world. In this connection, it is gratifying that the United Nations has unanimously adopted a proposal for establishing a new international agency for international co-operation in developing the peaceful uses of atomic energy. When organized it will probably be a Specialized Agency of the United Nations similar to the World Health Organization (WHO), the Food and Agricultural Organization (FAO), and the UNESCO. The United States has kindly agreed to make available to the proposed U.N. agency 220 lb. of fissionable material, *i.e.*, nuclear fuels, which could suffice for 15 research reactors, while 44 additional pounds would be made available by the United Kingdom. These would form an initial capital of energy-packed atoms for the operation of the future U.N. atomic energy agency.

Much interest centres round the forthcoming conference on August 8, 1955, when scientific delegates from some 80 countries will meet to study the technical and scientific factors involved and to explore the means required to develop atomic power on an international scale. Dr. H. J. Bhabha of India will be the President of the Conference, and Dr. Walter J. Whitman of the United States has been appointed Secretary-General.

A new world-picture is expected to emerge from that meeting. Authoritative surveys will be made of the world's power requirements between the years 1975 and 2000, including the needs and resources of specific regions and countries that are not yet industrialized, of others that are in transition from agricultural to industrial economy, and of countries that

are already industrial. Other sessions will discuss the availability of the raw materials for atomic fuels, the economics of nuclear power, the safety and health factors involved in atomic installations, the production and use of isotopes in industry, medicine and agriculture, and the legal problems involved. There will also be more technical sessions on the design and operation of nuclear reactors of various types, and on the fundamental facts and principles of chemistry, physics and biology upon which future developments must depend (including medical research on protection against radiation damage). A final session will discuss measures for the assistance of individual countries in the use of atomic energy, and the technical education of the experts who will be needed. The result will be a worldwide design for the peaceful uses of atomic energy and atomic materials.

But the promise of atomic power is so great that many countries are not waiting for United Nations action, but have already begun active developments. The Soviet Union has announced that the world's first electric power station to make practical use of atomic energy was put into operation on June 27, 1954. It generates 5,000 kilowatts of power for the use of neighbouring industries and agriculture, and larger stations, with a capacity of 50,000 to 100,000 kilowatts are under construction. In Great Britain, a 50,000 kilowatt atomic power station was begun in May 1953, at Calder Hall in Cumberland, and is expected to be in operation early in 1956. In the United States, where coal, oil and natural gas are both plentiful and cheap, it is not expected that electricity from atomic energy can be economical in competition with present power sources, but a 60,000 kilowatt plant is nevertheless being built near Pittsburgh at a cost of $ 30,000,000 in the hope that actual experience in its operation will result in a speedy reduction of future costs. Reports on these existing plants will undoubtedly be made at the Geneva Conference.

Yet very few nations have had actual experience in the full-scale operation of atomic reactors or of atomic power plants. The most immediate need is for information and training to spread the technology required on a wide scale. In order to construct reactors and carry on useful creative research in this field, not only is it necessary to have technical information on the subject—much of it already available—but one must also have scientists, engineers and technicians trained, at least to some degree, in the use and interpretation of these extremely complicated research tools.

This need has already been recognized in the United States, where a School of Nuclear Science and Engineering was opened at the Argonne National Laboratory near Chicago on March last. Thirty-one advanced students from 19 nations, and nine from the U.S. itself, have been admitted to this establishment. They have now begun a seven month study course in the design, construction and operation of reactors for nuclear research; in the principles of design of nuclear power reactors; in the handling of irradiated materials; and in other peaceful applications of nuclear energy. A series of additional courses will also be organized during the coming 12 to 15 months to bring essential basic knowledge and training to a total of 250 specialists from foreign nations. These additional courses are to be in industrial hygiene, in atomic biology and medicine, and in the techniques of using radioactive tracers. The U.S. proposals thus anticipate the future establishment of a United Nations atomic energy agency, and go beyond the direct generation of atomic power to the scientific and medical activities that must accompany it.

LADY TATA MEMORIAL TRUST SCHOLARSHIPS AND GRANTS FOR 1955-56

THE Trustees of the Lady Tata Memorial Trust announce on the death anniversary of Lady Meherbai Dorabji Tata, 18th June 1955, the awards of Scholarships and Grants for the year 1955-56.

The international awards of varying amounts (totalling £ 6,675) for research in diseases of the blood with special reference to Leucæmias are made to Doctors J. F. Kieler, J. Ringsted, J. Rygaard, N. A. Stenderup, F. Kissmeyer-Nielsen (all of Denmark), J. Nordmann and M. Seligmann (France), Professor H. Teir and Dr. C. G. V. Wasastjerna (Finland), Mr. S. Joseph and Dr. Alice Stewart (England) and Dr. A. Sreenivasan (Bombay).

Indian scholarships of Rs. 250 per month each for one year for scientific investigations having a bearing on the alleviation of human suffering from disease are awarded to Mr. N. A. Nityananda Rao (Bangalore), M. T. K. Sundaram (Madras), Doctors Prem Nath Satsangi and Satish Chandra (Lucknow), Dr. Mahendra Kumar Trambaklal Mehta (Patna) and Dr. Gangadhar Vyankatesh Bhide and Mr. U. W. Kenkare (Bombay).

ANTI-BACTERIAL ACTIVITY OF *RAUWOLFIA* ALKALOIDS

M. SIRSI AND M. O. TIRUNARAYANAN

Pharmacology Laboratory, Indian Institute of Science, Bangalore-3

RAUWOLFIA has come to occupy a prominent place in the therapeutics of high blood pressure[1-3] and psychic disorders.[4-7] While the use of this plant in hypertension is only of recent origin, the root had been employed for centuries in Indian medicine for the relief of various central nervous derangements, both psychic and motor, including anxiety, excitement, maniacal behaviour associated with psychosis and epilepsy. Removal of corneal opacities has been observed when the juice from the leaves of the plant were instilled into the eyes.[8] *Rauwolfia* has also been considered as specific for bowel disorders, including diarrhœas, dysentery and cholera. It has also been used as an anti-pyretic.[9]

Since this plant, *R. serpentina,* is mentioned as being very commonly used for bowel disorders, it is rather strange that no mention has been made as to the probable usefulness or otherwise of the drug in these clinical conditions, in spite of the intensive research work going on for the past ten years. Since specific remedies in the form of antibiotics and sulpha drugs are already available for such ailments, attention has probably been diverted towards hypertension and mental conditions for which no specific cure is yet available. However, it is known that many alkaloids possess antimicrobial activity, and have been used for various protozoal infections as specific remedies, *e.g.,* quinine in malaria, emetine in amœbic dysentery, and some of them also possess antibacterial activity.[10]

The alkaloids from the root were extracted with ammoniacal ethylene dichloride, the extract evaporated to dryness *in vacuo,* and the crude total alkaloids thus obtained were extracted with alcohol, filtered and once again dried *in vacuo.* The crude alkaloids have been found to be pharmacologically active in our other studies.[11,12] Reserpine, a pure crystalline alkaloid, was also investigated for its antibacterial properties. An 1% solution of the crude alkaloids in alcohol and a similar solution of reserpine in propylene glycol-alcohol-water mixture (1 : 1 : 2) were initially prepared from which further required dilutions were made. In every case, controls were run with the solvents alone. Results are presented in Tables I and II.

All the strains of organisms used were obtained from the King Institute of Preventive Medicine, Guindy, Madras, except the $H_{37}R_v$ strain of *Mycobacterium tuberculosis* var. *hominis* which was received from the National Collection of Type Cultures, Colindale, England. Youman's medium was used to evaluate the antitubercular activity by surface culture technique.[13] Filter-paper discs, saturated with drugs to be tested and placed on seeded plates of nutrient-agar and blood-agar, were used to determine the inhibitory action on other micro-organisms.

The results may be summarised as follows:

TABLE I

Bacteriostatic action of Rauwolfia *alkaloids* in vitro

Substance	Test Organisms								
	Staph. aureus	*Esch. coli*	*Eberth. typhosum*	*Eberth. paratyph.A*	*Eberth. paratyph.B*	*Shig. sonne*	*Shig. flexneri*	*Shig. shiga*	*Shig. schmitz*
Total alkaloids :									
1 : 10 dilution	22	18	16	12	20	23	10	12	10
1 : 100 dilution	20	13	15	11	17	13	10	10	9
Alcohol (solvent used above for)	–	13	15	11	10	–	–	–	–
Reserpine 1 : 10 dilution	13	–	–	–	–	–	–	–	–
Propylene glycol (solvent for reserpine)	12	–	–	–	–	–	–	–	–

Figures indicate zone of inhibition in mm.; – = No inhibition of growth.

TABLE II

Antitubercular activity of Rauwolfia *alkaloids*

(Youman's media : Surface culture method)

$H_{37}R_v$ strain. Readings at the end of 3 weeks

Concentration 1 in	Total alkaloids	Alcohol (solvent for total alkaloids)	Reserpine	Pr. Glycol mixture (solvent for reserpine)
1,000	–	–	–	–
10,000	–	–	++	++
100,000	+	++	++	++
1,000,000	++	++	++	++
Control	++	++	++	++

– = No growth; + and ++ various grades of growths.

(*a*) the total alkaloids have activity against all the organisms tested.

(*b*) *Staphylococcus aurcus* and *Shigella sonne* are more susceptible than the other organisms.

(*c*) reserpine in 1/10 dilution has no anti-microbial property.

(*d*) no appreciable difference in the inhibitory concentration is noticed between the alkaloids and the solvents used against *Myco tuberculosis* $H_{37}R_v$. Hence, the alkaloids can be considered to be without anti-tubercular activity.

It is particularly significant that the total alkaloids inhibit the growth of *Staphylococci* and *Shigella sonne*. Many outbreaks of diarrhœas are, of late, being attributed to these two organisms, and hence, the use of *Rauwolfia* decoctions in such conditions may be explained. However, controlled clinical trials are essential to translate the "*in vitro* activity" to therapeutic use.

Thanks are due to Ciba Pharmaceuticals, Inc., Basle, for generous supply of reserpine ('Serpasil') and to the Himalayan Drug Co., for the roots of *Rauwolfia serpentina* (Benth.). The authors wish to thank Dr. K. P. Menon for valuable advice.

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USE OF HEAVY WATER IN ORGANIC CHEMISTRY

IN the organic synthesis section, Division of Pure Chemistry, National Research Council, Canada, the following organic compounds labelled with deuterium have been synthesized for use in chemical kinetics, photochemistry and spectroscopy.

(1) Decomposition of the carbide Mg_2C_3 with deuterium oxide gives an excellent yield of propyne-d, $CD_3C \equiv CD$. Several other compounds can be prepared from this material. For instance, chlorination gives 1, 1, 2, 2-tetrachloropropane-d_4, ($CD_3CCl_2CDCl_2$) from which, in turn, 1, 1, 1, 2-trichloropropene-d_2 or *cis*- and *trans*-1, 2-dichloropropane-d_4 can be prepared.

(2) Addition of deuterium bromide to a double or triple bond is another simple method of introducing deuterium into organic compounds. Thus acetylene-d_2 gives a quantitative yield of 1, 2-dibromoethane-d_4. Alternatively, deuterium bromide may be reacted with ordinary acetylene to give 1, 2-dibromoethane-1, 2-d_2. It has been possible to transform both of these compounds into others, *e.g.*, ethylene-d_4, ethyl-d_5 bromide, ethylene-d_4 oxide, etc.

(3) Deuteration of organic compounds can also be effected by exchange. Such reactions are catalysed by finely divided metals such as nickel or platinum. For example, benzene is easily deuterated to benzene-d_6 by repeated exchange with deuterium oxide in the presence of platinum black. Exchange reactions may also be catalyzed by acids or bases. Trichloroethylene readily exchanges its hydrogen for deuterium when heated with deuterium oxide containing a weak base. An example of an acid-catalyzed reaction is the conversion of malonic acid to malonic-d_2 acid-d_2, namely, $CD_2(CO_2D)_2$.

(4) Sometimes it is more expedient to prepare a compound by reacting a suitable starting material with deuterium oxide and then enriching the product by exchange. For example, about 20 exchanges are required to convert acetone to acetone-d_6. Considerable time is saved by just preparing deuterated acetone (about 90%) from deuteroacetylene and then enriching it by exchange with heavy water.

The greatest difficulties are encountered in the synthesis of compounds labelled with deuterium in a specific position. A discerning choice of starting material must often be made. For instance, when it recently became necessary to prepare butene-1-4, 4, 4-d_3, $CD_3CH_2CH = CH_2$, the problem was solved by reacting the halide $CCl_3.CH_2.CHBr.CH_2Cl$ with zinc and acetic acid-d. In another case, acetaldehyde labelled in the formyl group was prepared by applying Nef reaction to the deuterated nitroethane, $CH_3CD_2NO_2$. The formation of the acetaldehyde-d, disproved a mechanism proposed for the Nef reaction in 1950. These synthetic methods are being extended in several directions. (*N.R.C. Res. News*, Vol. 8, No. 2).

RECENT RESEARCHES IN THE PALÆONTOLOGIC DIVISION GEOLOGICAL SURVEY OF INDIA*

M. R. SAHNI

Palæontologist, Geological Survey of India

THE present article gives a short review of the various items of research carried out in the Department of Palæontology, Geological Survey of India, during the period of the First Five-Year Plan.

INVERTEBRATES

1. Orbitolines from the Indian Continent, Tibet and Pakistan and Age of the Associated Volcanic Series

M. R. Sahni and V. V. Sastri have made an exhaustive investigation of the orbitolines so far collected from Chitral, Gilgit, Kashmir, Central Himalaya and Tibet. These include, beside the new genus *Birbalina* (genotype *B. pulchra*, sp. nov.) allied to *Orbitolinella* Henson, the following new species and varieties: (*a*) Chitral: *Orbitolina chitralensis* (Aptian-Lower Cenomanian); (*b*) Gilgit: *O. cf. chitralensis;* (*c*) Kashmir: *O. kashmirica* (Aptian-Albian); (*d*) Tibet: *O. obesa;* (*e*) Burma: *O. raoi, O. wadiai* and *O. hukaungensis.*

As a result of detailed study, the authors conclude that the volcanic sequence in the Burzil Valley, Kashmir, should be equated to the Panjal Trap Series, not the Tertiaries, as proposed by Wadia, for such Tertiary genera as *Dictyoconoides. Alveolina,* etc., supposed to occur in the Burzil Valley sequence, were not found in any of the rock samples, while the so-called *Dictyoconoides* formerly identified in the Cretaceous sequence, are undoubtedly *Orbitolina.*

A detailed account will be published as a Monograph in the *Palæontologia indica.*

2. New Fossils from the Jurassic Rocks of Jaisalmer, Rajasthan

M. R. Sahni and N. C. Bhatnagar have investigated a Callovian fauna from Jaisalmer including the following: Genus *Jaisalmeria,* nov. (genotype *J. taylori,* sp. nov.). *Generic Diagnosis*: beak more or less erect, free of the dorsal umbo, characterised by well developed, sometimes sharply angular, submesothyrid beak ridges; deltidial plates probably disjunct; ornamentation consisting of numerous, fine, radiating lines.

Jaisalmeria taylori sp. nov.: shell broadly oval, somewhat depressed but almost equiconvex, biplicate. Beak small, erect, obliquely truncated by a small foramen. *Jaisalmeria depressa* sp. nov.: shell depressed, sub-pentagonal, incipiently biplicate, beak small, erect, beak-ridges well defined, enclosing a broad area below. *Jaisalmeria ovalis* sp. nov. var. *cuneata,* nov. is posteriorly narrow and possesses incipient dorsal sulcation separated by folds.

? *Kutchithyris jaisalmerensis* sp. nov.: shell ovate to subpentagonal; strongly biplicate, sub-fimbriate; beak massive, well incurved; beak-ridges permesothyrid; foramen large.

Hemicidaris jaisalmerensis sp. nov.: test small, circular around the ambitus. Oral surface flat, apex arched; ambulacra almost straight, poriferous zone straight or very slightly flexuous; pore pairs unigeminal becoming bigemminal near the peristome; interambulacral areas wide; madreporic plate pentagonal; ocular plates small, triangular, exsert; genitals comparatively large, pentagonal.

3. New Unionids from the Triassic (Gondwana) Rocks of Tihki, Vindhya Pradesh and Maleri, Hyderabad, Deccan

M. R. Sahni and A. P. Tiwari have described for the first time, the only known Triassic unionid fauna from India. This includes the new genus *Tihkia* with much thickened shell. inconspicuous, anteriorly situated (not terminal) beaks, curved inward and forward; flat, smooth umbo; lunule, opisthodetic ligament and characteristically strong concentric corrugations in later stages. Pseudocardinals prominent.

Species: *T. corrugata,* with sharp upward anterior curvature moderate inflation, prominent, elongate opisthodetic ligament. *T. navis*: inflated, subquadrate, boat-shaped. *T. compressa* is broadly oval and compressed. *T. subangulata* is subtriangular and characterised by an oblique external ridge.

4. Discovery of *Eurydesma* and *Conularia* Horizons in the Eastern Himalaya and Description of Their Faunas

M. R. Sahni and J. P. Srivastava record the discovery of *Eurydesma* beds in Sikkim, E. Himalaya and of a *Conularia*-bearing horizon in the Subansiri Division, N.E.F. Agency. The Sikkim fauna represents the Agglomeratic slate horizon of Kashmir with which the beds are lithologically identical,

* Published by permission of the Director, Geological Survey of India.

The Subansiri fauna includes *Conularia laskeri* sp. nov. and the new genus *Subansiria*, combining characters of *Syringothyris* and *Pseudosyrinx*. A detailed account of the fauna is being published in the Inaugural Volume of the *Journal of the Palæontological Society of India*.

5. A Lower Miocene (Gaj) Fauna from Travancore-Cochin, South India

M. R. Sahni and M. V. A. Sastry have investigated a fossil assemblage (coll.: A. Damodaran) from Edavai, the Travancore coast, homotaxial with Quilon Limestone fauna. The assemblage includes: *Antillia miocenica* sp. nov. with a simple, turbinate, slightly curved corallum; thin, dentate septa disposed in six systems and five incomplete cycles, and a columella. *Calamophyllia miocenica* sp. nov. has a cyclindrical corallite with mural thickenings, and a few wavy, thin, rounded costæ; the septa are wide apart and there is no distinct columella.

The presence of *Breynia carinata, Discors triforme* and *Tectus loryi* reported for the first time from this part of Peninsular India, confirms that the Quilon beds are of Gaj (Lower Miocene) age.

VERTEBRATES

6. A New Classification of the Indian Deinotheres and Description of *D. orlovii* sp. nov.

M. R. Sahni and C. Tripathi have studied the entire *Deinotherium* material in the Geological Survey collections. A new species, *D. orlovii*, has been established on the characters of its upper dentition, P^3 and P^4 being characterised by additional tubercles not seen in any other Indian species. M^2 in *D. pentapotamiæ* is square, whereas in *D. orlovii* it is transversely elongated. This is a special character of the upper molars of *D. orlovii*. On the basis of new material, *D. indicum* var. *gajense* has been placed in synonymy with *D. pentapotamiæ* and *D. sindiense* with *D. indicum*. *D. pentapotamiæ* and *D. indicum* considered synonymous with each other and with *D. giganteum* by earlier workers, are here regarded as independent species.

D. pentapotamiæ and *D. indicum* are separable on jaw characters. In *indicum*, the mandible bulges out on either side below M_3 yielding a nearly circular section, which is laterally compressed in *D. pentapotamiæ*. There are also differences in their dentition. All the lower teeth of *D. indicum*, except P_3 possess a tubercle each on their outer sides. In M_1 a tubercle is found only at the outer entrance to the valley between the proto- and meta-lophids while in M_2 and M_3, the transverse valley made by the proto- and meta-lophids is guarded by tubercles on both sides. The lower dentition of *D. pentapotamiæ* lacks this character.

Both in *D. sindiense* and *D. indicum*, M_3 and M_2 are characterised by tubercles at the entrances to the valley between the proto- and meta-lophids. Similarly, *D. indicum* var. *gajense* was based on an M_3 found in *alveolus*. Other type specimens of *D. indicum* var. *gajense* do not show any difference from *D. pentapotamiæ*, a conclusion supported by the new material at our disposal.

D. pentapotamiæ ranges from Gaj to Chinji and *D. indicum* from Kamlial to Dhokpathan, while *D. orlovii* is known to occur only in the Kamalaials.

STRUCTURE OF CHROMOSOMES

PROFESSOR HANS RIS of the Wisconsin Zoology Department has evolved a valuable theory on the internal structure of chromosomes. The findings which led to Prof. Ris' theory were made with the electron microscope which showed that chromosomes are made up of many tiny fibrils coiled like a corkscrew and about 25 millimicrons thick.

Though a great deal is known about the chemical composition and properties of chromosomes, Prof. Ris' effort to describe their internal structure will help enormously to explain how chromosomes are put together and why they behave the way they do. It has also been noticed that the chromosomes in many different types of plant and animal cells all have fibrils of the same width as basic units.

During cell division, chromosomes split lengthwise, and each half goes to a daughter cell—furnishing the master pattern which the daughter cells follow in growing into a likeness of the parent. By this means, old cells of tissues and organs are replaced with new young cells identical in structure and function. Division is also the means by which sperm cells and ova are created, each containing the chromosomal master pattern of a parent, which merge to produce an offspring with characteristics of both parents. During the process of cell division, the tiny fibrils apparently enlarge until they are twice as thick—or 50 millimicrons—and then split lengthwise, thus giving rise to two new fibrils.

GEOMETRICAL MECHANICS AND DE BROGLIE WAVES*

HAMILTON'S dynamical method is familiar to mathematical physicists, but his optical method seems to be known only to those interested in the theory of optical instruments. This method deals with rays and waves in three-dimensional space. Synge, by extending this method to space and time, has developed a general and completely relativistic theory of de Broglie waves.

Hamilton's theory starts from a variational principle $\delta\int v ds = 0$, where v is a medium-function or index of refraction, depending on position and direction, and from this principle one can construct the properties of rays and waves associated with them. This theory involves neither wavelength nor frequency. Maxwell's theory, on the other hand, starts from a set of partial differential equations and the solution of any optical problem depends upon the exact solution of these equations with suitable boundary conditions. In between these methods there lies what we call physical optics, which takes Hamilton's theory and extends it by adding the concepts of wavelength, secondary waves and interference. Exactly the same thing could be done with the relativistic geometrical mechanics. Newtonian mechanics is based on the principle of Maupertuis $\delta\int v ds = 0$, where v is given in terms of energy by $\frac{1}{2} mv^2 = E - V$. By incorporating the idea of de Broglie waves, we get what we may call "Physical Mechanics" which bears the same relation to Schrödinger wave mechanics as does physical optics to Maxwell's theory.

After a historical discussion given in the first chapter Synge introduces the concept of a medium-function $f(x, a)$ which is a positive homogeneous function of position co-ordinates $x_r (r = 1, 2, 3, 4; x_4 = ict)$ and a unit 4-vector a_r such that $a_r a_r = -1$, $a_4 ti > 0$. Rays in space-time are defined as curves satisfying the variational principle $\delta\int f(x,d)ds = 0$, for fixed end-points, ds being the Minokowskian element, so that $ds^2 = -dx_r\, dx_r$. From this he has developed a general theory of rays and waves in space-time. By taking suitable forms for the medium function Synge has dealt with the geometrical mechanics for a free particle, a particle in a field, a charged particle in a given electromagnetic field, and de Broglie waves for a particle in a central field of force.

Chapter IV deals with the process of 'quantizations' which means that the adjacent events A and B of equal phase on a ray satisfy the relation

$$\int_A^B f ds = h.$$

This leads to the well-known fine structure formula for the hydrogen atom, and also a formula for the energy levels of a hydrogen-like atom in a weak magnetic field. The last chapter deals with some generalizations of the theory, developed in the previous chapters, to N-dimensional space.

The reviewers have enjoyed reading the book and can confidently recommend it to those interested in this subject of great physical interest.

D. S. KOTHARI.
F. C. AULUCK.

* *Geometrical Mechanics and de Broglie Waves.* By J. L. Synge, Cambridge University Press, 1954, pp. 167, 25 *s.*

BERYLLIUM-7 FROM COSMIC RAYS

IN his classic paper of 1946 (*Phys. Rev.*, 1946, 69, 671), W. F. Libby predicted the existence of cosmic-ray-induced radioactivities in the atmosphere, in particular C^{14}, with a half-life of 5600 yr. and tritium, with a half-life of 12·4 yr. Both nuclides have now been discovered and used to study a wide variety of processes having time-scales comparable to their respective half-lives. Carbon-14 is made by low energy neutron capture in nitrogen, whereas tritium results chiefly from high-energy interactions, or "stars".

Two other nuclides may be expected to result from these high-energy interactions in nitrogen and oxygen. These are Be^7 with a half-life of 53 days, and Be^{10} with a half-life of $2{\cdot}5 \times 10^6$ yr. Because of their well-spaced half-lives, these species should be of geochemical interest. The discovery of Be^7 produced by cosmic rays has been reported by James R. Arnold and H. Ali Al-Salih in *Science* (1955, 121, 451). The authors observe that interestingly enough Be^7 is the easiest of all the cosmic-ray-produced nuclides to detect, despite its comparatively low production rate, because it occurs substantially carrier-free.

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INVESTIGATION OF VERTICAL MOVEMENTS OF THE F_2 LAYER

Periodic fading of short wave radio signals in the early morning and late evening hours was interpreted by the previous workers[1,2] as due to the interference of two waves either singly and doubly reflected from one layer or singly reflected from two different layers (E and F_2) when one or both the layers have a slow vertical movement. When the received signal consists of singly reflected waves from both the layers, they have assumed that both the layers will move with the same velocity. Since the F_2 layer is known to have larger height variations than the E layer, it is felt that the assumption made above is not quite justified. So, by taking the vertical velocities of the two layers to be different, the formula was modified from which the F_2 layer velocity can be determined by substituting the previously known value of the E layer velocity obtained from medium wave records taken during the same time. The modified formula takes the form

$$n = (2/\lambda)\ (v_1 \cos \phi_1 - v_2 \cos \theta_1)$$

where n is the fading frequency, λ is the wavelength of the received signal, ϕ_1 and θ_1 are the angles of incidence of the two rays on the F_2 and E layers of the Ionosphere and v_1 and v_2 are the respective vertical velocities of the two layers. Substituting the E layer vertical velocity obtained from medium wave records taken separately during the same time, we can easily calculate v_1 if we determine the periodicity in a short wave fading record.

Madras B transmitting station radiating on 4920 Kc/s. was selected and the signals were recorded with the usual c.w. recording technique in the evening hours at about 6 O' clock and it was found that the condition was favourable to receive both the singly reflected waves from the two layers. The average value of the layer lifting velocities for the E layer during the month of October 1953, in the evening hours was found to be 2·3 metres/s. Using this value the layer lifting velocities for the F_2 layer obtained on three typical days are shown in the table.

S. No.	Date	Period in secs.	Velocity m./s.
1	8-10-53	14·7	3·7
2	8-10-53	16·1	3·45
3	9-10-53	19·4	3·02
4	9-10-53	16·0	3·47
5	10-10-53	18·2	3·16

From the table it is evident that F_2 layer velocity is definitely greater than that of E layer as was expected. More reliable values for F_2 layer velocities can be obtained by taking simultaneous records on short and medium waves from the same station so that the exact E layer velocity during the same time may be determined. The results thus obtained for the F_2 layer velocity can be checked by obtaining records showing periodicities due to the interference of $1F_2$ and $2F_2$ reflections from the layer. The full details of these investigations will be published elsewhere. The author has great pleasure in expressing his gratitude towards Dr. B. Ramachandra Rao for his kind and inspiring guidance.

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TEMPERATURE DEPENDENCE OF THE MAGNETIC SUSCEPTIBILITY OF SODIUM AND POTASSIUM

The study of the magnetic susceptibility of the alkali metals has assumed great interest in recent years because of the theoretical importance from the point of view of the weak spin paramagnetism of the conduction electrons in metals. Several authors have previously studied the susceptibilities of the alkali metals but their values show a large disparity among one another and with the values calculated from theoretical considerations. Also, with regard to the study of the variation of the susceptibility of these metals with temperature, the results so far available are very divergent in nature and as such no definite conclusions could be arrived at.

In the present investigation a study of the susceptibilities of sodium and potassium has been made between room temperature and about 120° C. by the Curie method using a large electromagnet of Pye type. Pure oxide-free metals were used in the test bulbs. Also a correction for any ferromagnetic impurity that might be contained in the metal has been applied for every bulb experimented upon using the method of Honda and Owen.[1] The average specific susceptibility values for Na and K at room temperature as obtained in this investigation are $+0{\cdot}575$ and $+0{\cdot}455$ respectively.

Three Na bulbs and three K bulbs were subjected to temperature variation from 30° C. to 120° C., *i.e.*, over a short range on either side of their melting points. The heating was done by an electrical heater and the temperatures were measured by a previously calibrated thermo-couple. At every temperature, the susceptibility was found at different field strengths and the correction for the ferromagnetic impurities was applied to each bulb. Table I summarises the values obtained in this investigation.

Table I

Sodium		Potassium	
Temperature ° C.	$\chi \times 10^6$	Temperature ° C.	$\chi \times 10^6$
30	·575	30	·450
50	·575	42	·450
67	·580	58	·460
84	·590	67	·435
94	·600	86	·435
105	·560	105	·440
120	·560		

The results obtained show a slight but definite increase in susceptibility as the melting point is approached. As fusion takes place the values fall down abruptly by a small amount. In the case of potassium a slight increase in the value is observed as the temperature is increased beyond the melting point. These observations are in general agreement with the results obtained by Sucksmith.[2] The contribution by the free electrons to the susceptibility $(\chi_A)_e$ of a gram atom of Na works out to be 20·12 and $(\chi_A)_e$ for K is found to be 32·73. The width V_0 of the energy band in volts for the free electrons is calculated to be 1·59 and 0·98 for Na and K respectively. This indicates a narrowing of the energy band as suggested by Stoner.[3] Fuller details will be published elsewhere.

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BENEFICIATION OF VERMICULITE

VERMICULITE, an alteration product of phlogopite and biotite micas, finds innumerable industrial applications by virtue of its low thermal and electrical conductivity. The mode of occurrence, origin, uses and the methods of beneficiating low grade vermiculite have been reviewed exhaustively in a recent paper.[1] In literature, there is scanty reference to tabling as a means of beneficiation of this mineral. Though heavy media separation has been reported by Sullivan and Bird[2] and sink-float separation of exfoliated vermiculite by Hidehiko Mino *et al.*,[3] the efficiency of separation in the different size ranges has not been mentioned. Hence work has been undertaken with three samples of vermiculite received from the Mysore Geological Department. The grade of vermiculite is fixed by its bulk density "B.D.", which is the weight in lb./c. ft. of the exfoliated material and its "exfoliation index", which is the ratio of the volume of the original material to the volume of the exfoliated product. The best qualities of vermiculite bulk 6 lb. or less/c. ft. after being exfoliated,[4] and the average exfoliation index varies from 12-18.[5] The B.D. and exfoliation index have been determined by heating the sample in a muffle furnace at 982° C. for 5 minutes.[6]

Of the three samples investigated, one was from Bageshpura and the other two from Malavanghatta, designated herein as Malavanghatta I and Malavanghatta II. The first was pale bronze yellow to grey in colour while the other two were pale greyish yellow to black. The samples consisted of coarse lumps together with fines, and screen analyses have been done. The following gangue minerals were found to occur with vermiculite as small granules of irregular shape and in a highly altered condition: quartz, felspar, hornblende, serpentine, clay, magnetite, laterite, apatite and granitic gneiss.

Tabling experiments were done on a laboratory Wilfley table, with different size fractions (Bulk, +10, −10/+60, −60/+120 and −120 mesh B.S.S.) of the material to study the extent of separation of the value from the gangue. The gangue minerals collected at the concentrate end of the table, while the clay and slime segregated to the tail end leaving a good middling product. In the tabling experiments of the samples with different size-ranges, although there was clear separation of vermiculite from silicate gangue minerals up to +60/mesh, the best grade obtained with the samples was from the +10 mesh fraction. The +10/mesh Bageshpura sample after tabling bulked 9·0 lb./c. ft. with exfoliation index of 5·6 and a recovery of 94·3%. The +10/Malavanghatta I and II samples bulked after tabling 14·9 and 13·7 lb./c. ft. with recoveries of 69·0 and 70·7% respectively.

In the heavy media separation of vermiculite from Bageshpura in the same size-fractions, with bromoform alcohol mixture, sp. gr. 2·52, vermiculite could be floated off from the gangue; owing to the very small difference in specific gravity between the Malavanghatta samples and the gangue, separation was done after exfoliation with carbon tetrachloride, sp. gr. 1·58. In general it has been found that desliming yields a slightly higher grade of vermiculite. The unexfoliated +10 Bageshpura sample after heavy media separation bulked 9·8 lb./c. ft. with 94·6% recovery, while the exfoliated sample after separation bulked 11·2 lb./c. ft. with 73% recovery. The exfoliated Malavanghatta I and II samples after heavy media separation bulked 14·5 and 13·9 lb./c. ft. with recovery of 74·0 and 80·7% respectively. A magnetic separation of the gangue minerals has also been effected.

It has been found that the grade and recovery are good in the + 10 fraction, and the sample from Bageshpura appears to be the best of all the specimens. Work on the flotation of vermiculite is in progress. Fuller details will be published elsewhere.

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THE BENZOPHENANTHRIDINE RING SYSTEM

THE appearance of a paper by Cook, Loudon and McCloskey[1] in the current issue of the *Journal of the Chemical Society* prompts us to place on record results connected with an allied work. 7-Methyl-tetra-hydroquinoline was condensed with o-nitro-benzyl chloride yielding N-(o-nitrobenzyl)7-methyl-1, 2, 3, 4-tetrahydroquinoline (C: 72·5, H: 6·6). The corresponding amino-derivative could not be purified even though it gave all the common tests for a primary aromatic amine. The crude oily base was dissolved in dilute sulphuric acid, diazotised, freshly precipitated copper powder added and slightly warmed when a vigorous evolution of nitrogen took place. The resulting tarry mass yielded no basic material. We then turned our attention to the corresponding nitro-benzoyl derivative and work was in progress when the abstract of a paper by Mitshuhashi[2] reached us. The Japanese author had observed that the diazotisation of o-amino-benzoyl-arylamines results in triazole condensation instead of Pshorr reaction. He suggested that if the imino hydrogen of the acid-imino group is replaced by a benzyl group, Pschoff reaction would occur. In support of this he effected the cyclization of o-amino-benzoyl-N-benzyl-aniline. The ring closure of o-amino-benzoyl-carbazole by Plant and Tomlinson[3] is of interest in this context. We therefore decided to apply the Mitsuhashi hypothesis to the benzphenanthridine series. O-Nitro-benzoyl-chloride reacted with N-benzyl-α-naphthylamine to give the amide m.p. 161 (C: 75·1, H: 4·7). The corresponding amine was diazotised and treated with copper powder to yield N-benzyl-benzophenanthridone, m.p. 252 from alcohol (C: 85·2, H: 5·1). The corresponding benzophenanthridones using o-nitro-veratric acid and o-nitropiperonylic acid respectively were obtained fairly easily. 6-Nitro-veratroyl-N-benzyl-α-naphthylamine, m.p. 138 from alcohol (C: 70·3, H: 5·0) yielded the amino derivative, m.p. 149 from alcohol (C: 75·4, H: 6·0) and then the 2, 3-dimethoxy-N-benzyl-11-keto-benzphenanthridine, m.p. 196 from alcohol, (C: 78·7, H: 5·5). 6-Nitro-piperonyl-N-benzyl-α-naphthylamine, m.p. 180 (C: 70·8, H: 4·5), was reduced, diazotised and ring closed to give 2, 3-methylenedioxy-N-benzyl-11-keto-phenanthridine, m.p. 190-dec. (C: 79·6, H: 4·5). Work in this field and in the allied pyrrocoline group has been resumed after an unavoidable break in continuity.

Dept. of Org. Chemistry, K. K. MATHEW.
University of Madras, B. S. PAI.
Madras-25, K. N. MENON.
February 15, 1955.

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MONOFLUO-ARSENATES AND THEIR ANALOGY WITH SULPHATES

CHEMICAL analogy between monofluophosphates $(PO_3F)''$ and sulphates are well known from the researches of Lange[1] and Goswami.[2] As P and As show close analogies in the phosphates and arsenates, search for analogous fluo-derivative of As, that is, fluo-arsenate $(AsO_3F)''$ has been deemed necessary. A note on the existence of such fluo-arsenates was published by G. Mitra[3] recently. He however failed to prepare any pure salt, simple or double. He simply observed the formation of mixed crystals by isomorphous replacements by various compounds, *e.g.*, $ZnSO_4$ (AsO_3F) $7H_2O$, etc. A method different from that of Lange has been described by Audrieth[4] in his "Inorganic Synthesis" for the preparation of $(PO_3F)''$. Following this method using potassium meta-arsenate and potassium fluoride, we have been able to prepare potassium fluo-arsenate K_2AsO_3F in quantity directly. Other alkali metal salts and bivalent metal salts were

prepared by double decomposition between the potassium salt and the corresponding metallic perchlorates. The salts of Na, K, Co or Cd have been prepared and analysed.

Preparations of other simple and also double salts including alums are in progress.

Our best thanks are due to Prof. P. B. Sarkar for kindly suggesting the problem.

Inorg. Chem. Lab., N. K. DUTT.
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CHOLINE CONTENT OF SOME SOUTH INDIAN FOODSTUFFS

THE importance of choline as a nutritional factor has been recognised for long. Fatty livers and hæmorrhagic kidneys in rats and mice and perosis in chicks and turkeys have been ascribed to a dietary deficiency of choline.[1] Choline deficiency as an ætiological factor in human fibrosis of the liver has been repeatedly affirmed.[2-7] Information on its distribution in foodstuffs is limited. K. Ahmed *et al.*[8] and H. Chattopadyaya and S. Banerjee[9] have determined the choline content of some common foodstuffs in Bengal. The possibility of a variation in the chemical composition of foodstuffs grown in two distant regions cannot be ruled out. So a determination of choline in some of the more common South Indian foodstuffs was made.

Samples of the food material were collected from the Vellore market at different periods of the year. They were dried free of moisture and powdered. Two methods of extraction were tried and both gave a complete extraction of choline. In the first 2-10 g. of the material containing 4-8 mg. choline was extracted continuously for 24 hours with 50-100 ml. of methyl alcohol in a Soxhlet extractor. In the second the material was extracted with 10 times its weight of 70% ethanol by grinding in a mortar. The method used for the estimation of choline in the extract was essentially that of Engel.[10]

TABLE I

Total choline of South Indian foodstuffs

Name	Choline content expressed as choline chloride on dry basis (mg./100 gm.)		
	Present Investigation	K. Ahmed *et al.*[8]	H. Chattopadyaya and S. Banerjee[9]
CEREALS, PULSES AND NUTS			
Wheat (*Triticum vulgare*) ..	69·8 (±1·1)*	..	70 (±1·8)*
Polished Rice (*Oryza sativa*) ..	44·8 (±1·4)	88	70 (±1·8)
Rice Polishings ..	nil	..	..
Cholam (*Sorghum vulgare*) ..	41·9 (±0·9)	..	..
Ragi (*Eleusine coracana*) ..	16·9 (±0·8)	..	..
Cambu (*Pennisetum typhoideum*) ..	38·2 (±1·4)	..	..
Maize (*Zea mays*) ..	nil	..	nil
Dhall Arhar (*Cajanus indicus*) ..	147·5 (±1·5)	209	201 (±2·2)
Bengal Gram (*Cicer arietinum*) ..	225·2 (±1·1)	215	245 (±1·6)
Green Gram (*Phaseolus radiatus*) ..	139·1 (±1·2)	185	205 (±2·5)
Black Gram (*Phaseolus mungo*) ..	137·5 (±1·4)	232	99 (±1·5)
Horse Gram (*Dolichos biflorus*) ..	189·5 (±1·8)	..	..
Bean (*Dolichos lablab*) ..	148·6 (±1·5)	391	..
Peas (*Pisum sativum*) ..	206·2 (±0·8)	280	..
Cow Gram (*Vigna catiang*) ..	215·5 (±1·5)	..	..
Groundnut (*Arachis hypogea*) ..	177·5 (±1·5)	244	..
VEGETABLES			
Brinjal (*Solanum melogena*) ..	276·0 (±1·0)	1145	..
Potato (*Solanum tuberosum*) ..	32·52 (±0·4)	400	..
Yam (*Typhonium trilobatum*) ..	22·85 (±0·4)	..	..
Colacasia antiquorum ..	64·73 (±0·9)	..	..
Sweet potato (*Ipomea batatas*) ..	nil	..	..
Plantain Green (*Musa paradisiaca*) ..	14·78 (±0·4)	..	..
Cabbage (*Brassica oleracea capitata*) ..	125·5 (±0·5)	1500	..
Tomato (*Lycopersicum esculentum*) ..	76·4 (±0·8)	..	..
Onion (*Allium cepa*) ..	82·5 (±0·5)	..	..

* Values given in brackets represent standard deviation of the result.

Choline reineckate was determined by a photoelectric colorimeter using the yellow green (520 mμ) filter, and calibration was done using pure choline chloride. The colorimetric method was found to be suitable for estimation of choline in the range of 2-10 mg. Recovery experiments were done by adding a known quantity of choline chloride to a sample of the biological material and estimating the total choline. The recovery was of the order 98-101%.

The values given in Table I and compared with values reported in literature represent an average of over 30 individual estimations in each case. It is seen from Table I that the cereals and the more common vegetables are low in choline. Maize and sweet potato do not contain any choline at all. Unlike the vitamins of the B group, no choline is lost during polishing rice.

It is a pleasure to express my thanks to Dr. S. C. Devadatta, for his advice and interest in the work.

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Christian Medical College,
Vellore, South India,
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SPECTROPHOTOMETRIC STUDY OF THE KINETICS OF FERRIC THIOSULPHATE REACTION

THE coloured intermediate produced by the reaction of thiosulphates with ferric salts has been assigned the formula $FeS_2O_3^+$ by Schmid,[1] Haldar and Banerjee,[2] Page[3] and Ricca and Faraone.[4] The rate of decay of this labile-coloured intermediate has been studied spectrophotometrically in the visible region. The plot of percentage of transmission against time gave the familiar S-shaped curves and the plot of optical density against time produced similar curves but turned upside down. Fig. 1 shows typical results obtained at 5000 A, when 6 c.c. of M/100 solution of sodium thiosulphate were added to equal volume of M/100 ferric chloride solution containing N/10 hydrochloric acid.

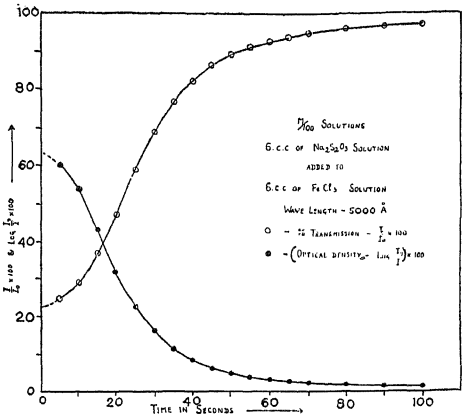


FIG. 1

These curves clearly show that the rate of decay increases gradually, attains a maximum value and then falls off with time. The curves can be extrapolated to give the percentage of transmission or the optical density at zero-time. The general characteristics of the curves do not change with the purity of the materials and water used or with the change of wavelength in the visible region. Using very dilute solution of ferric perchlorate in perchloric acid, the general characteristics of the curve have been observed even in the ultraviolet region. While at high ionic strength the shape of the curve is unaffected, presence of excess of hydrogen ions greatly suppresses the marked acceleration in the rate. Addition of cupric ion or increase in the concentration of thiosulphate ion simply accelerates the rate of decay. The nature of the curves warrants that the decay of the coloured $FeS_2O_3^+$ should involve an intermediate for which we propose the formula $Fe(S_2O_3)_2^-$. This second intermediate should not be identified with the coloured intermediate of Holluta and Martini[5] now established to be $FeS_2O_3^+$.

We propose the following mechanism for the decay reaction of the coloured intermediate $FeS_2O_3^+$ or as a matter of fact for the ferric thiosulphate reaction:

$$Fe^{3+} + S_2O_3^{2-} \rightleftharpoons FeS_2O_3^+ \quad (1)$$
$$FeS_2O_3^+ + S_2O_3^{2-} \rightarrow Fe(S_2O_3)_2^- \quad (2)$$
$$Fe(S_2O_3)_2^- + Fe^{3+} \rightarrow 2Fe^{2+} + S_4O_6^{2-} \quad (3)$$
$$FeS_2O_3^+ + Fe(S_2O_3)_2^- \rightarrow 2Fe^{2+} + S_4O_6^{2-} + S_2O_3^{2-} \quad (4)$$

Both portions of the reversible reaction (1) have been shown by Schmid to be very fast and therefore, the rate of decay will depend on the comparatively slower reactions (2), (3) and (4). It is evident that at zero-time, when the

concentration of $FeS_2O_3^+$ is maximum, that of $Fe(S_2O_3)_2^-$ is nil.

It can be predicted from the above mechanism that the rate of decay of $FeS_2O_3^+$ would not be maximum at the beginning but would attain the maximum value after a period of time. This expectation has been fulfilled. Further, it can be said that the rate of reduction of ferric ion and the rate of consumption of thiosulphate would behave similarly in attaining a maximum value after a time which may be termed as the period of induction.

The kinetic equation as derived from our mechanism along with the discussion of the experimental results will be published elsewhere.

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MICRO-METHOD FOR ESTIMATION OF NICOTINE GROUP OF ALKALOIDS IN TOBACCO PLANTS

IN our investigation on the study of biogenesis of nicotine group of alkaloids in the tobacco plants by *in vitro* tissue culture technique, difficulties were first encountered in selecting a suitable micromethod by which small amount of nicotine could be accurately measured. As no such method was reported in the literature a suitable micromethod based on the cyanogen bromide and aniline colour reaction as applied in case of nicotinic acid estimation by Swaminathan[1] and Melnick,[2] has been developed to measure nicotine group of alkaloids in the above plants.

In this method the nicotine alkaloids were distilled off from tobacco leaves powder in alkaline medium by steam and collected in 5 ml. of 1 : 1 hydrochloric acid upto a definite volume of 300-500 ml. To 1 ml. of this distillate was then added 1 ml. of 50 ml. sodium acetate buffer adjusted to pH 7, 2 ml. of aqueous aniline solution followed by 12 ml. of cyanogen bromide solution, mixed well and after 10 minutes the colour was matched against a suitable standard of nicotine solution by using photoelectric colorimeter.

The per cent. of nicotine determined by this method (3·2% of dry leaves) almost corresponded with that obtained by titration method in which nicotine distilled off from alkaline medium was absorbed in 5 ml. of N/10 sulphuric acid upto 500 ml. and the total alkaloid determined by back titration against N/10 sodium hydroxide.

Taking different batches of leaf samples varying from 2 g.-40 mg. it was noted that the small amount of nicotine as present in 40-50 mg. of leaves corresponding to 2 μg. of nicotine per c.c. of the distillate collected, could be accurately estimated by this method. In case of lesser amount below 2 μg. per ml. the intensity of colour developed was too faint to give any appreciable deflection in the galvanometric scale of the colorimeter. Process of "intensification of the colour" by adding 2 mg. of nicotine to both unknown and standard helped to measure even lesser amount of nicotine below 2 μg.

Accuracy of the method was further evaluated from the experiment on the per cent. recovery in which it was noted that 1 mg. of nicotine mixed with tobacco leaf powder and distilled in the usual way, gave a recovery to the extent of 96-98%.

Investigation on the effect of distillate volume on per cent. recovery showed that at distillate collection of 100-200 ml., recovery of nicotine in the distillate was only 60-70%. Maximum recovery of 96-98% was obtained at the distillate volume of 300 ml. and above.

This micromethod has been successfully utilised in our investigation on the study of the biogenesis of nicotine alkaloid in different parts of tobacco plants by *in vitro* tissue culture technique with various amino acid precursors and the results will be communicated in due course.

The present method is not only suitable for nicotine estimation but also for all other pyridine alkaloids like nor-nicotine anabasine, etc., and further investigations are in progress to apply this method for the estimation of all the pyridine group of alkaloids by separating these by paper and column chromatographic techniques.

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DISTRIBUTION OF TASTERS AND NON-TASTERS AND A-B-O GROUPS

THE inability to taste phenylthiourea is transmitted as a Mendelian recessive, and has been variously assessed[1-3] between 5 and 30%.

The present investigation was undertaken to get an idea of the percentage of 'tasters' and 'non-tasters' amongst the students of Kasturba Medical College coming from all parts of India. First a 1 in 20,000 dilution was chosen. A small quantity of the solution was put into the mouth of each person who was asked to tell the taste. While many gave clear-cut replies, some were doubtful about the taste. So, a higher concentration, *i.e.*, 1 in 10,000 was tried. At this dilution all of them gave an answer one way or the other.

The A-B-O grouping of each student was also estimated by the standard slide technique using high titre Blood Grouping Sera. One hundred and fifty-five students were tasted in all, of whom 60·6% were tasters and the rest non-tasters. The distribution per cent. of the A, B, O and AB groups was respectively 23·9, 28·4, 40·0 and 7·7.

The distribution of tasters and non-tasters in the different blood groups is given in Table I.

TABLE I

	A	B	O	AB	Total
No. of Tasters ..	26	26	35	7	94
No. of Non-tasters ..	11	18	27	5	61
% of Tasters ..	70·3	59·1	56·5	58·3	60·6
% of Non-tasters ..	29·7	40·9	43·5	41·7	39·4

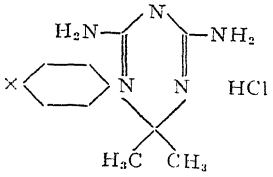
It is interesting to note that a dilution of 1 in 10,000 proved sufficient for the sampling. We are unable to confirm the findings of Ford[1] that both types can usually tell the taste in concentrations of 400 parts per million. A few of the non-tasters were given the phenylthiourea powder itself to taste. They were not able to tell the taste.

Kasturba Medical College, A. KRISHNA RAO.
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EFFICACY OF PROGUANIL AND DIHYDROTRIAZINES AS ANTIMALARIALS

ISOLATION of an active dihydrotriazine metabolite of proguanil[1] (I; X = Cl) stimulated interest in the field of dihydrotriazines as potential antimalarials.[2-5] During the course of synthesis[4] and testing[9,10] of similar compounds, it was considered worthwhile to obtain a comparative picture about the efficacy of proguanil, its active metabolite and a similar dihydrotriazine (I; X = SO_2NH_2) which has been claimed[6] to be very promising. Bioassay of these compounds against *P. gallinaceum* was undertaken following the technique adopted by Jaswant Singh *et al.*[7]; while against *P. knowlesi* (Nuri strain), the technique was similar to the one outlined by Nair *et al.*[8]



(I)

TABLE I

Comparative efficacy of proguanil, its metabolite and 1-p-*sulphonamidophenyl*-1 : 6-*dihydro*-2 : 4-*diamino*-6 : 6-*dimethyl*-1 : 3 : 5-*triazine*

Drug	Minimum effective dose in mg./kg./b.w.	
	P. gallinaceum	*P. knowlesi*
Quinine ..	32·0	35·0
Proguanil ..	2·0	0·2
Proguanil Metabolite (I; X = Cl)	0·06	35·0
Dihydrotriazine (I; X = SO_2NH_2)	128 to 256	inactive up to 50 mg.

* No clearance of parasite upto 125 mg.

The M.E.D. of quinine against *P. gallinaceum* and the virulent Nuri strain of *P. knowlesi* are nearly equal while proguanil is 10 times more effective against the latter infection. On the contrary, proguanil metabolite (I; X = Cl), in spite of its superiority over the parent drug against *P. gallinaceum*,[1,10] has given erratic results against *P. knowlesi*. For instance, doses as low as 0·2 g. were effective in some cases, but a consistently effective response[9] (complete clearance of blood parasites) in at least 5 monkeys could be obtained only with doses as high as 35 mg./kg. body weight. The sulphonamide substituted dihydrotriazine (I; X = SO_2NH_2),

on the other hand, has shown poor response even against the avian plasmodia. When tested against *P. knowlesi* in doses ranging from 5-125 mg./kg. body weight, it failed to clear the blood parasites in all cases. Consequently, it seems unlikely that these two dihydrotriazines, especially the latter, will be suitable for the treatment of acute attacks of malaria.

Malaria Inst. of India, Delhi-8,
March 28, 1955.

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COMPARATIVE ACTIVITY OF RESERPINE AND TOTAL ALKALOIDS OF *RAUWOLFIA*

Rauwolfia serpentina Benth. has been and is still used in India in the form of crude powder or tablets from crude powder or as solid or liquid extracts containing total alkaloids and the oleo-resinous fractions. With the discovery of 'reserpine', which is claimed to be the main sedative principle of this drug,[1,2] preparations containing this isolated alkaloid have come to be employed in Europe and America for therapeutic purposes where *R. serpentina* is indicated. Wilkins[3] reported that the clinical effects of 1 part of reserpine compared favourably with 1000 parts of *Rauwolfia* root powder. The yield of reserpine being 0·1%, Wilkins' work would indicate that the entire activity of the crude drug might be due to its chief alkaloid 'reserpine'. The following investigation was undertaken to decide whether reserpine alone was responsible for the entire activity of *R. serpentina* or the other constituents of the plant also possessed some activity.

Serpasil ampoules containing 2·5 mg. reserpine per ml. were used for the pure principle and 'Serpina' tablets containing total alkaloids of *R. serpentina* were used for the crude drug.* Rhesus monkeys weighing 1,500-1,750 g. were employed in this study. Monkeys were fed orally on empty stomach and observed for 48-72 hours at suitable intervals. The animals were re-employed after a rest period of 10-12 days. Cross-over test was employed for final evaluation of the preparations.

Repeated observations show that 5 mg. of reserpine is equipotent with 6 tablets of Serpina. In these doses, both drugs produce noticeable depression for 36-48 hours. The effect can be appreciated 3-4 hours after medication which becomes maximum in 10-12 hours. At this stage, the monkeys lose total interest in their surroundings. They offer no resistance when disturbed or handled. Diarrhœa occurred in some monkeys with this dose of either drug.

Serpina tablets were analysed for reserpine content following a method reported elsewhere.[4] They contain 0·38 mg. per tablet so that six tablets would contain 2·28 mg. of reserpine. This work, therefore, shows that reserpine alone is not responsible for the total activity of the drug. Rescinnamine, another alkaloid isolated from *R. serpentina* by Klohs *et al.*,[5] has been claimed to be the second sedative principle of the plant by Cronheim *et al.*[6] Quantitatively it is considered to be as potent as reserpine. However, rescinnamine was present only in negligible amounts in 'serpina' tablets. So it is difficult at this stage to say whether there are some other C.N.S. depressant constituent or constituents in *R. serpentina*, or the effect of reserpine is potentiated in the presence of other alkaloids. Anyhow it is quite clear that the C.N.S. depressant activity of *R. serpentina* is not represented in reserpine alkaloid alone.

Some other points of significance that have been noted during the course of this work are: (*i*) The monkeys require much larger dosage of reserpine than dogs, rabbits, cats, etc. Nearly 3 mg./kg. orally was required to put the monkey to sleep and make them lose interest in surroundings for 12-24 hours. This is in confirmation of findings of Plummer, *et al.*[7] (*ii*) Reserpine dissolved in P.A.W. (Propylene glycol : Alcohol : Water, 1 : 1 : 4) had greater and quicker effect than when given suspended in water alone, apparently due to quicker absorption from the gut.

Thanks are due to Dr. M. M. Dhar for analysing Serpina tablets for reserpine.

Central Drug Res. Inst., J. D. KOHLI.
Lucknow, B. MUKERJI.
April 11, 1955.

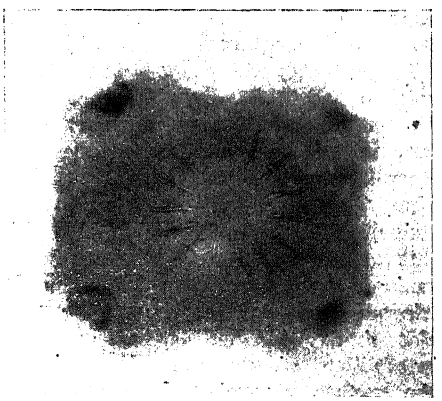
* Serpasil ampoules were kindly supplied by M/s. Ciba Pharma Ltd. Serpina tablets were kindly supplied by M/s. Himalayan Drug Co., Bombay.

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AN UNUSUAL RECORD OF *TAENIA* WITH A SINGLE CIRCLE OF HOOKS FROM A DOG

THE members of the family Tæniidæ are characterised by the rostellum-bearing two circles of hooks, a single set of reproductive organs and the uterus in the form of a median stem.

Hall[1] divided the genus *Tœnia* into three groups, *viz.*, (*i*) *Tœnia* in which the rostellum bears two circles of hooks, (*ii*) *Tœnia saginata* when the head is unarmed, and (*iii*) *Tœnia monostephanos* when the head bears a single circle of hooks. The *Tœnia* worms with double circle of hooks are quite common and are found in greater frequency in the dog, cat and man, while those with a single circle of hooks are rare. Linstow[2] recorded a *Tœnia* with a single circle of hooks from a Lynx



(Lynx lynx) in Russia and named it *T. monostephanos*. In this species as reported, the hooks are without handle and appear rose-thorn shaped. Later Honess[3] reported another species, with a single circle of hooks from a badger (*Taxidea taxus taxus*) describing it under the name *Fossor angertrudæ*. In this form the hooks appear to possess well developed guard and are smaller in size when compared with a tæniid hook. Most of the authors are of the opinion that the former is a teratological or traumatic form of *Tœnia*. Wardle and Mcleod[4] have justly remarked that until further specimens of Honess's form are recorded the genus *Fossor* must be regarded *sub judice*.

During the course of study of tæniid cestodes of dogs and cats from Bombay State, the authors came across a tapeworm possessing a single circle of hooks, instead of two. But the worm was quite indistinguishable morphologically from other *Tœnia* excepting for the hooks and the length of the body, which is smaller than *Tœnia hydatigena*. The rostellum on closer examination did not show any indication of scar-like tissue, being formed as a result of damage or traumatic injury. The hooks measure 118 μ and resemble the small hooks of the ordinary *Tœnia* of dogs in shape and size. The number of hooks encountered is 13 (2 are probably damaged). The length of the body is 250 mm. long. The detailed morphology and the identity of the worm is in progress and will be published elsewhere. This record is of interest because it might throw some light on the possibility of an existence of a *Tœnia* with one circle of hooks.

Bombay Veterinary College, L. S. HIREGAUDAR.
Bombay, S. R. RAO.
February 22, 1955.

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PROTEIN CATABOLISM IN THE DEVELOPING EGG OF *PILA VIRENS*

THE present note reports the study on the nitrogenous waste products in the developing egg of *Pila*. Lal and Saxena[2] have recently studied the nitrogenous excretion in the adult *Pila*.

Extracts of eggs were prepared and tested for ammonia, urea and uric acid according to the methods given by Hawk, *et al.*[1] For the

estimation of ammonia the aeration method of Van Slyke and Cullen, for urea the urease method of Van Slyke and Cullen and for uric acid the method of Benedict and Franke was used. Till the third day no trace of nitrogenous waste product could be detected, probably due to the negligible amounts produced. A trace of nitrogenous waste product in the form of ammonia was first observed on the fourth day. Table I gives the result of the analysis at different stages of development after this period.

TABLE I

Age	Ammonia N μg.	Urea N μg.	Uric acid N
4 days ..	16·5	nil	nil
7 days ..	32·6	35·2	nil
8 days ..	28·8	49·0	Traces*
10 days ..	20·2	67·2	Traces*
Just hatched	nil	58·2	Greater amount

* Determined qualitatively.

Pila illustrates Needham's view[3] that the choice between ammonio-, ureo- and urico-telism is determined by the conditions under which embryonic development takes place. It is well known that eggs of *Pila* are not laid actually in water but in moist mud in which situation rapid removal of toxic substances, as they are formed, is not possible as in an aquatic environment. As Lal and Saxena[2] have shown, there is an alteration of ureotelism and uricotelism depending on whether the animal (which is amphibious) lives in water or out of it. The detoxication of ammonia by its conversion into urea and uric acid is related to life under terrestrial conditions of limited water supply or non-availability of water, as in the case of hibernating animals. In the developing egg the later stages of which are spent under less moist or nearly dry conditions, there is a sequence of ureotelism and uricotelism. This succession is similar to the recapitulatory parallelism described by Needham[3] for the chick.

My thanks are due to Prof. R. V. Seshaiya for guidance.

Dept. of Zoology, (MISS) V. R. MEENAKSHI.
Annamalai University,
December 23, 1954.

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CRUSTACEAN WOOD BORERS OF VISAKHAPATNAM HARBOUR

IN the course of our survey of the marine wood-boring organisms in the Visakhapatnam harbour we noticed decided attacks of wood-boring crustaceans along with molluscan borers. In India very little work has been done on the crustacean wood-borers in spite of economic interest attached to such studies. The only work on the subject is that of Erlanson[1] who reported two species of the Isopod genus, *Sphæroma*, from Cochin harbour.

We have recognized, so far, three species of Isopod wood-borers belonging to two distinct genera in the local harbour. They are *Metoponorthus* sp. belonging to the family Oniscidæ and two members of the family Sphæromidæ (*Sphæroma terebrans* and *S. walkeri*) commonly termed as 'Pill-bugs'.

Metoponorthus sp. is the most important crustacean borer in Vizag harbour. It measures about 7 mm. in length with a width of 2·5 mm.; abdominal somites rarely coalesced; body flattened; antennules quite vestigial; antennæ long, its peduncle bearing five segments; mandible devoid of a palp. The sexes are separate and a small number of eggs are laid by the female to be carried in a brood pouch between the bases of the legs on the underside of the body. The young, when hatched, differ only in size from the adults. While all members of the family Oniscidæ so far described are terrestrial in habitat, it is interesting to observe that this is the first record of an oniscid having become marine and developing wood-boring propensity. While these forms are found in large numbers in fishermen's catamarans, only very few were noticed in timber jetties. This may be due to the difference in the types of wood used in catamaran and jetty logs. Some idea of the abundance of *Metoponorthus* sp. in badly infested timbers may be gauged from the fact that as many as 50-100 individuals of all ages may be contained in 3 square inches area.

Sphæroma terebrans and *Sphæroma walkeri* are generally found in the jetty logs. *S. terebrans* has a uniform drab dark hue. It measures about 8·5 mm. in length. The hinder segments of the body have a transverse row of prominent tubercles. The telson is decidedly sloped from its base having a row of tubercles similar to those of other segments and, in addition, numerous smaller ones, which give the surface a roughened appearance. In *Sphæroma walkeri* the telson bears two indefinite longitudinal rows of tubercles and this

structure is more strongly concave with the edges curved upwards than in *S. terebrans*.

Besides these three important wood-boring crustacea another form, *Cirolana* (Cirolaninæ) is often collected in wooden jetties in the local harbour. Whether it is actually a wood-borer or whether it merely infests the holes made by other wood-borers is not fully established.

Our grateful thanks are due to Dr. Robert J. Menzies of the Scripps Institution of Oceanography, California, for identifying the Isopods, *Metoponorthus* sp. and *Cirolana*.

Dept. of Zoology, P. N. GANAPATI.
Andhra University, R. NAGABHUSHANAM.
March 18, 1955.

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CELLULASE ACTIVITY OF THE CRYSTALLINE STYLE OF THE WOOD-BORING PELECYPOD *BANKIA INDICA* NAIR

IT is well known[1-3] that the principal diet of the wood-boring teredines is wood. In view of this specialised diet and since the wood particles in the cæcum are found to be in a state of dissolution, showing a considerable amount of reducing sugars, it was inferred that the crystalline style may contain a cellulose-splitting enzyme.

To test whether the above assumption is valid, the style extract of *Bankia*, a common shipworm infesting the fishing floats in the Madras waters, was tested for cellulase by Newell's method,[4] using a suspension of regenerated filter-paper as the substrate and measuring the turbidity in a Klett-Summerson colorimeter using a red filter (wavelength 640 $m\mu$). The reducing sugars formed were estimated by the Somogyi method.[5] Extracts of 1% (w/v), of the style were prepared by homogenising the style in M/15 phosphate buffer at pH 5·9 which was found to be the optimum pH for style cellulase.

Five tubes A, B, C, D and E were set up each with an equal volume of reaction mixture as shown in Table I.

The decrease in turbidity in the tubes D and E containing the active enzyme is clear from the readings in Table I.

The amount of cellulose left as residue after the action of the enzyme, was estimated on 5 ml. samples and compared with those in which enzyme was not added. It was found that whereas in A and B, 12·3 and 12·6 mg. of cellulose was found, in D and E the amount of cellulose had decreased to 7·8 and 7·9 mg. respectively due to its hydrolysis into soluble sugars indicating cellulase activity.

Table showing the turbidity readings (Klett-Summerson) for different reaction mixtures

Tube	Hours 0	1	2	3	4	6	8	20
Control 1. A (without enzyme)	225	222	220	222	220	225	220	220
Control 2. B (boiled without enzyme)	220	220	218	220	216	220	220	220
Control 3. C (boiled with enzyme)	400	400	396	396	400	398	398	398
Active 1. D	380	375	360	354	340	330	318	295
Active 2. E	380	373	664	357	343	327	320	297

The extent of digestion was also verified by estimating the sugars found as a result of the activity of the enzyme at intervals of 5, 10, 20 and 24 hours on 5 ml. samples. The volume differences in titre values for the above periods were 5·3; 7·0; 8·9 and 9·6 respectively, showing the increase in the amount of sugar formed and the progress of digestion.

A chromatographic analysis was made to determine the end products formed by enzymic hydrolysis of cellulose (details are reserved for a fuller paper) which revealed that cellobiose and glucose are the end products. Since the author has found[3] the presence of cellobiase activity in the digestive diverticula of *Bankia*, it is probable that the cellulase liberated by the crystalline style hydrolyses the cellulose into cellobiose first, which is further converted into glucose by the cellobiase of the digestive diverticula. This conclusion is supported by that of Levinson *et al.*,[6] who found cellobiose as an intermediary in the process of cellulose breakdown in fungal metabolism.

I thank Dr. C. P. Gnanamuthu and Dr. G. Krishnan for help in the preparation of this paper and Dr. P. S. Sarma for laboratory facilities.

Zoology Lab., N. BALAKRISHNAN NAIR.
University of Madras,
April 4, 1955.

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NIHERITANCE OF RESISTANCE TO WILT (*FUSARIUM LINI* BOLLEY) IN LINSEED

RUST, caused by *Melampsora lini* (Pers) Lev., and wilt, caused by *Fusarium lini* Bolley, constitute two serious diseases of the linseed crop over a great part of India. Breeding for rust resistance carried out at this Institute has resulted in the evolution of a number of economic strains immune to rust. One or more of these rust-resistant strains have done better than the local improved strains in many States of India and some States have already taken steps to multiply their seed for distribution to growers.[3] The genetics of rust resistance in this crop was reported by Deshpande and Jeswani.[2]

TABLE I

Showing the wilt reaction in the parents and F_1's

Parents and F_1's	Number of plants grown	Number of plants wilted
N.C. 5-2	12	..
N. C. 4-14	17	1
Bison 69	15	..
Bison 70	21	..
Dakota	17	..
Sheynne	16	..
B. 5128	19	..
N.P. (R.R.) 405	23	23
N.P. (R.R.) 407	14	14
N.P. (R.R.) 438	15	13
N.P. (R.R.) 494	18	17
F_1 N.C. 5-2×N.P. (R.R.) 494	16	..
F_1 N.C. 4-14×N.P. (R.R.) 405	13	..
F_1 N.C. 5-2×N.P. (R.R.) 407	21	..
F_1 Bison 69×N.P. (R.R.) 438	12	..
F_1 Bison 70×N.P. (R.R.) 438	15	..
F_1 Dakota×N.P. (R.R.) 438	18	..
F_1 B. 5128×N.P.(R.R.) 405	16	..
F_1 N.P. (R.R.) 405×B. 5128	15	..
F_1 Sheynne×N.P. (R.R.) 405	22	..

From a survey of the relevant literature, it appears that very little work has been done on the inheritance of resistance to wilt in linseed. Burnham[1] and Dillman,[4] while observing that resistance to wilt in linseed was an inherited character, did not report any definite Mendelian ratios. Tisdale[5] failed to find evidence of simple genetic ratios in respect of inheritance of this character and concluded that wilt resistance in flax was apparently determined by multiple factors.

We have recently observed that some strains, which were rust-resistant, also showed a high degree of resistance to wilt. For studying the inheritance of wilt resistance, nine cross-combinations between wilt-resistant and wilt-susceptible strains were effected during 1951-52. A part of the crossed seed was utilised in 1952-53 for growing the F_1 generation at Delhi and seed was collected from these plants for raising the F_2 progenies. During 1953-54, the parental strains and the corresponding F_1 and F_2 progenies were grown at the Institute of Plant Industry, Indore, in a plot made wilt-sick by means of artificial inoculation with the wilt organism. The results obtained are presented in Tables I and II.

The results presented in Tables I and II strongly suggest that resistance to wilt in linseed is an inherited character, resistance being dominant over susceptibility. In the F_2 generation, the progenies from cross Nos. 2, 3, 7 and 8 showed a segregation of 3 resistant : 1 susceptible, while those from cross Nos. 1, 4, 5, 6 and 9 gave the ratio of 15 resistant : 1 susceptible. Although the number of plants per F_2 progeny was rather small, the results clearly indicate that, in the material studied, resistance to wilt is governed by a pair of duplicate genes, resistance being dominant over susceptibility.

We are grateful to the Director, Institute of Plant Industry, Indore, for giving the facilities

TABLE II

Showing the wilt reaction in the F_2 generation

	Cross	Number of plants grown	Number of plants wilted	Expected Ratio	χ^2	P value limits
1.	N.C. 5-2×N.P. (R.R.) 494 ..	18	1	15 : 1	0·013	0·95-0·90
2.	N.C. 4-14×N.P. (R.R.) 405 ..	26	6	3 : 1	0·073	0·80-0·70
3.	N.C. 5-2×N.P. (R.R.) 407 ..	43	13	3 : 1	0·628	0·50-0·30
4.	Bison 69×N.P. (R.R.) 438 ..	30	2	15 : 1	0·008	0·95-0·90
5.	Bison 70×N.P. (R.R.) 438 ..	21	1	15 : 1	0·081	0·80-0·70
6.	Dakota×N.P. (R.R.) 438 ..	26	2	15 : 1	0·091	0·80-0·70
7.	B. 5128×N.P. (R.R.) 405 ..	30	7	3 : 1	0·044	0·90-0·80
8.	N.P. (R.R.) 405×B. 5128 ..	24	5	3 : 1	0·222	0·70-0·50
9.	Sheynne×N.P. (R.R.) 405 ..	22	2	15 : 1	0·302	0·70-0·50

and to Mr. Merh of that Institute, for arranging for the wilt-resistance tests.

Division of Botany, Indian Agri. Res. Inst., New Delhi, *February* 15, 1955.
R. B. DESHPANDE.
L. M. JESWANI.

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A CHROMATOGRAPHIC STUDY OF THE AMINO ACIDS (AND SUGARS) OF HEALTHY AND DISEASED LEAVES OF *ACALYPHA INDICA*

AN attempt has been made to study chromatographically the changes in the amino acid as well as the sugar content of the leaves of *Acalypha indica* (a common weed) due to the yellow mosaic condition of the leaves. The authors observed that the plants show a 'mosaic' pattern in the top leaves whereas the leaves below were quite green and healthy.

Various methods[1,3] of circular paper chromatography were tried. The best results were obtained by making use of the modification made by Ranjan *et al.*[2] A circular piece of Whatman filter-paper No. 1, diameter 27 cm. having 12 equal sectors separated by 12 radial cuts, was used for the purpose. Drops of known volume (0·002 ml.) of both the water extract as well as the acid-hydrolysate were kept at the positions located for the purpose. Index solutions were kept at six different places (A, B, F, H, I and J) to facilitate the identification of the bands.

The chromatogram was run with butanol-acetic acid-water (4 : 1 : 5) with a single paper wick in the centre for 7 hours. It was then dried at room temperature (25° C.) and sprayed with 0·1% ninhydrin solution in acetone.

The hydrolysate both of the healthy and mosaic leaves showed the presence of leucine and isoleucine (Band I), valine and methionine (Band II), tyrosine (III), alanine (IV), glutamic acid and threonine (V), glycine and aspartic acid (VI), arginine (VII), histidine and lysine (VIII), cystine (IX), but absence of serine. The water extract in both cases showed the existence of only tyrosine (I), glutamic acid and threonine (II), serine (III), and arginine (IV), but the bands were more intense with the 'mosaic' leaves.

The content of the free amino acids increased in the case of the 'mosaic' leaves. A separate study of sugars by the same method and using aniline-hydrogen phthalate as spraying reagent showed that the sugar content decreased in the case of the 'mosaic' leaves.

We are grateful to Prof. S. Ranjan for his encouragement and to Shri K. S. Bilgrami for his valuable help.

Dept. of Botany, University of Allahabad, Allahabad, *December* 10, 1954.
M. M. LALORAYA.
GOVINDJEE.
T. RAJA RAO.

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EXTERNAL MORPHOLOGY OF THE SOLDIER OF *ODONTOTERMES OBESUS* (RAMBUR)

WITH a view to study the detailed morphology of the higher Indian termites, of which none has so far been worked out, *Odontotermes obesus* (Rambur) (Isoptera, family Termitidæ) was selected. The external morphology of the soldier caste has been worked out in detail.

The head is of the prognathous type. Some of the cranial sutures present in primitive insects are wanting here. The principal areas of the cranium are the vertex, epicranial region, frons, clypeus, genæ and mandibularia dorsally, and the occiput, postocciput, postgenæ and postmentum ventrally. The tentorium consists of the main body or corporotentorium and two pairs of tentorial arms, the anterior and the posterior.

The antennæ are usually with 16-17 segments, rarely with 15. In some colonies 16-segmented forms, and in others 17-segmented forms, predominate. Many individuals show asymmetry in the number of antennal segments in the right and left antennæ, but the difference is never more than one.

The mandibles are sharp and sabre-shaped. The left mandible bears a small tooth which is generally absent in the right one. The cervix or neck is provided with two pairs of cervical sclerites, an anterior and a posterior one.

The thorax is well developed, especially the pronotum. There are two pairs of thoracic spiracles, one pair each on the meso- and metathorax. The legs are slender, the hind leg being the longest. The tarsi are 4-segmented.

The abdomen is 10-segmented; of these the first eight bear the spiracles laterally. All the ten terga are clearly developed. The first sternum is atrophied; the remaining nine are well developed. The last or tenth segment bears laterally a pair of subanal styles and, lateral to them, a pair of cerci. It is not possible to distinguish the sexes in the soldier caste.

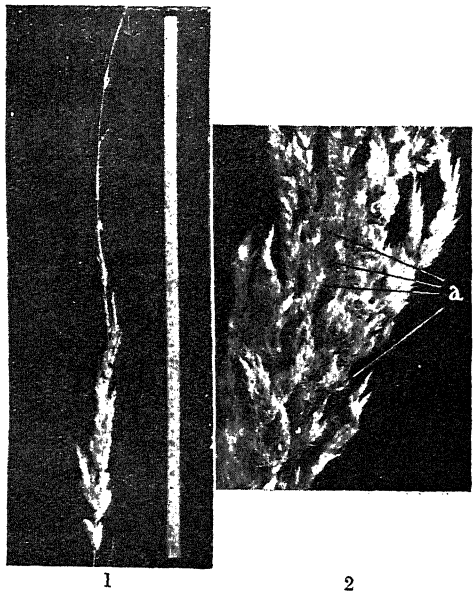
A fuller account will be published elsewhere.

Entomology Branch, K. S. KUSHWAHA.
Forest Res. Inst., Dehra Dun,
March 8, 1955.

ABNORMAL ARROWING IN *ERIANTHUS MUNJA* (ROXB.), JESW.

IN sugarcane, Lyon[1] and one of the authors[2] recorded formation of foliar structures in whorls at apex in the place of an arrow. In this note a similar phenomenon in *E. munja* (Roxb.), Jesw. is reported.

In April 1953, an abnormally long arrow more than a metre in length (Fig. 1) was



1 2

FIG. 1. Abnormal arrow of *Erianthus munja*.
FIG. 2. A portion of the same magnified to show green foliaceous structures (*a*).

found to emerge in a clump of *E. munja* planted near the cage-house in the laboratory area. Detailed observations made in the following summer showed that three of the forms of *E. munja*, namely, W.S. 7, W.S. 14 and N/5, produced arrows which were greatly elongated (Table I). Some flowers were normal in all respects and had functional sex organs, as shown by the percentage of anther dehiscence and pollen viability. But in a majority of them, not only had the glumes turned green, but other floral parts also got transformed into green foliaceous structures (Fig. 2).

TABLE I

Abnormal arrowing in* Erianthum munja *(Roxb.), Jesw.*

Particulars	Type of arrow	W.S. 7	W.S. 14	N/5
Abnormal arrows measured		5	11	5
Maximum length of inflorescence in cm.	Normal	76·0	86·0	64·0
Average length of inflorescence in cm.	Abnormal	137·0	96·0	128·0
	Normal†	56·8	77·8	54·4
Minimum length of inflorescence in cm.	Abnormal	65·6	51·7	94·5
	Normal	48·0	45·0	47·0
	Abnormal	19·0	19·0	48·5
% AntherDehiscence	Normal	99·3	90·7	100·0
	Abnormal	30·2	80·5	71·2
% Viable pollen	Normal	96·1	98·6	98·4
	Abnormal	48·4	88·1	88·6

* In Bihar *Erianthus munja* usually flowers in November-December. Abnormal arrowing was noted in April-May 1954.
† Average of 15 measurements.

E. munja, like sugarcane[2] appears to behave as a short-day plant. It is likely that the unfavourable long days of summer might have resulted in the transformation of floral structures into foliar ones and in the increased vegetative growth of the rachis.

Grateful thanks are due to Sri. K. L. Khanna for kindly providing facilities for this work.

Central Sugarcane Res. Station, S. L. SHARMA.
R. C. SRIVASTAVA.
Pusa, Bihar, *March* 8, 1955.

1. Lyon, H. L., *Haw. Plant. Rec.*, 1926, **31**, 249.
2. Sharma, S. L., *Curr. Sci.*, 1953, **9**, 276.

CYTOLOGICAL AND EMBRYOLOGICAL INVESTIGATIONS IN THE ASCLEPIADACEÆ

THE family Asclepiadaceæ has not received much attention from embryologists and cytologists. Venkata Rao and Rama Rao[1] in a recent paper have reviewed the literature on the embryology of the family and described in detail the morphology and embryology of *Cryptostegia grandiflora* and *Caralluma attenuata*, while the cytology has been studied by Moyer,[2] Bowden[3] and a few others.

Investigations on the embryology and cytology of the family are in progress in this laboratory for some time, and the present note gives

a brief account of the observations made so far.

The development of the female gametophyte in *Tylophora asthmatica*, *Pentatropis microphylla* and *Leptadenia reticulata* corresponds to the "Polygonum type". The ovules are anatropous and tenuinucellate. The archesporial cell is hypodermal in origin and directly functions as the megaspore mother cell. A normal linear tetrad of megaspores is formed, the chalazal of which functions. The mature gametophyte shows the presence of starch grains and the antipodals are ephemeral.

Cytological investigations show that meiosis is regular. The chromosome number of the plants, so far investigated, is as follows :

	n	$2n$
Tylophora asthmatica W. & A.	11	22
Pentatropis microphylla W. & A.	11	22
Leptadenia reticulata W. & A.	11	..
Dœmia extensa Br.	11	22
Pergularia pallida W. & A.	..	22

It is interesting to note that polysomaty has been observed in roots of *Tylophora asthmatica*.

A full account of the investigations including other aspects will be shortly published elsewhere.

My thanks are due to Dr. I. Banerji, under whose guidance the investigation is being carried out.

Dept. of Botany, INDU SEKHAR BISWAS.
Calcutta University,
February 10, 1955.

1. Venkata Rao, C. and Rama Rao, S., *J. Indian Bot. Soc.*, 1954, **33**, 453.
2. Moyer, L. S., *Bot. Gaz.*, 1936, **97**, 860.
3. Bowden, W. M., *Amer. J. Bot.*, 1940, **27**, 357.

ENVIRONMENT AND RATE OF GROWTH OF EMBRYO IN *BRASSICA CAMPESTRIS* VAR. *TORIA*

THE present study was undertaken to understand the effect of temperature on fertilisation and the rate of growth of embryo in *B. campestris* L. var. *toria* Duth. & Full. Plants from colchicine-induced tetraploid cultures (11th and 12th generation) were chosen; the tetraploids were particularly well suited since they continue to flower for a longer period than the diploids, thereby rendering a study under widely differing conditions of temperature possible.

The material for study was fixed during two seasons. The first fixation was done in 1952 from 12th February to 3rd March and the second in the next crop from 28th December to 27th January. The mean minimum and maximum temperatures during a day in the two fixation periods ranged from 54·0-78·6° F. in the former, and 41·8-65·8° F. in the latter. In both the years ovaries were fixed in the experimental plots at 3, 5, 10 and 20 days after pollination, and also after 30 days in the year 1953; they were processed by the usual paraffin technique and stained by the safranin and fast-green schedule. In all, about 285 ovules were examined and the observations are summarised in Table I. It should be mentioned that there was some variation in the stages that could be seen in different ovules fixed at the same stage. The stage shown by the maximum number of ovules was taken for purposes of comparison.

TABLE I

Days after pollination	Stage of embryo development	
	Early bloom (December-January)	Late bloom (February-March)
3	Fertilisation just over	Zygote ready to divide
5	2–3 celled proembryo	Dermatogen differentiated
10	Quadrant to octant stage	Heart stage
20	Heart stage	Cotyledons well formed and the embryo curved
30	Cotyledons well formed and the embryo curved	Stage not studied

Total number of ovules studied = 285. Number of plants used for the study : (i) early bloom = 2, (ii) late bloom = 2.

From Table I, it appears that the rate of development of embryo was faster in the late bloom fixations than in the early bloom ones. Such a difference may be attributed to the differences in the environmental conditions, mainly temperature and day length, prevalent during the two periods when the fixations were made. The late bloom period was characterised by warmer days and with longer light hours than the early bloom period. (In a highly cross-fertilised crop as *toria*, large variations in the growth rate are only to be expected. But as more than one plant was taken for comparison, the marked difference in the growth rate is attributable to environment. Plants among the late bloom group and early bloom group did not differ among themselves

widely, in this regard.) From the present study it would appear that the rate of growth of ovaries in late bloom is faster, presumably due to environmental conditions, consequently leading to their quick maturity. The observations are in accord with those made by Chinoy[1] who found that wheat varieties in late-flowering classes require fewer days for grain ripening compared to those in the early ones. Further he[2] found that when early varieties were induced to flower late the ripening period was shortened due to high temperature. On the other hand, when flowering was accelerated in late varieties the ripening period was considerably lengthened due to low temperature.

Incidentally, emphasis may be laid on the necessity of reporting the nature of environmental conditions at the time of fixation in such studies.

I am thankful to Dr. S. M. Sikka for encouragement, and to Dr. P. N. Bhaduri, Mr. S. S. Rajan and Dr. M. S. Swaminathan for their useful comments.

Division of Botany, Y. R. AHUJA.
Indian Agric. Res. Inst.,
New Delhi-12, *January* 17, 1955.

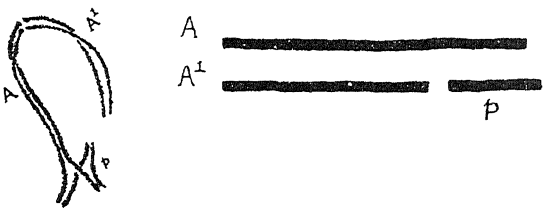
1. Chinoy, J. J., *Nature*, 1947, **159**, 442.
2. —, *Curr. Sci.*, 1949, **18**, 414.

UNEQUAL BIVALENT IN *EURYBRACHIS* (FULGORIDAE HOMOPTERA)

UNEQUAL bivalent is said to be of rare occurrence and the observations of the same were merely incidental to other investigations.[2] No record is available of a Hemipteran insect showing 'unequal bivalent'. In the spermatogenesis of *Eurybrachis apicalis* one unequal bivalent occurs.[1] This is the first record of a hemiptera, revealing the existence of an unequal bivalent in a natural population. It is very clear only at diplotene.

In this note an attempt is made to explain the nature and origin of the unequal bivalent in *Eurybrachis apicalis*. The explanation is based on an interesting configuration (Fig. 1), which is very clearly seen in a diplotene nucleus. The unequal bivalent is seen in association with a small bit of a chromosome. However, there is a single chiasma in between. Such a configuration was seen in only one diplotene nucleus, and hence its complete history cannot be worked out. Nevertheless, some conclusions are possible. They are as follows:

1. The small bit (p) belongs to the shorter partner (A_1 in Fig. 1) of the unequal bivalent.



1 2

FIG. 1. Showing unequal bivalent in association with a small bit of a chromosome (p). A single chiasma is clearly seen in between them. A and A_1 represent the long and short partner of the unequal bivalent. p, represents a portion of chromosome A_1 and which is lost in most cases in *E. apicalis*, except the solitary case ($\times 3{,}200$).

FIG. 2. Represents diagrammatic representation of deletion of a small bit of a chromosome resulting in the unequal bivalent in *Eurybrachis*.

2. It points to the recent origin of the unequal bivalent in *Eurybrachis apicalis*. [While this small bit of a chromosome (p) is lost in almost all cases, at least in one solitary case it was present.]
3. The origin of unequal bivalent is due to a deletion which is heterozygous in nature (Fig. 2).
4. The portion which is lost is the euchromatic one, and not heterochromatic as reported in most cases.[2]

Dept. of Zoology, S. R. VENKATASUBBA RAO.
Birla College of Science,
Pilani, *March* 23, 1955.

1. Rao, S. R. V., *Studies on the Spermatogenesis of Indian Homeoptera.* Part I. Meiosis in Two Species of *Eurybrachis Chromosoma*, 1955 (in press).
2. White, M. J. D., *Animal Cytology and Evolution*, 1954, 2nd Ed., Cambridge.

EFFECT OF NUTRITION AND STARVATION ON THE SUSCEPTIBILITY OF *CORCYRA CEPHALONICA* STAINT. TO CARBON DISULPHIDE

SUN[1] observed that the rate of growth and susceptibility of larvæ of *Tribolium confusum* Jaq. Duv. reared on eight different combinations of food, varied with the nature of food when they were subjected to carbon disulphide fumigation. After testing the effect of starvation with adults of *Sitophilus granarius* Linn. and *Tribolium confusum*, two of the Coleopterous pests of storage as test insects, he concluded that starvation may cause a slight lowering of the mortality so far as metabolism is

concerned while, on the other hand, starvation will decrease the vitality of the insects as a result of which their resistance to fumigants will decrease.

Laboratory experiments were carried out at the Entomology Division of the Indian Agricultural Research Institute with fourth stage caterpillars of *Corcyra cephalonica* Staint., one of the Lepidopterous pests of storage, as test insects. The caterpillars were reared on five different foods, namely, crushed groundnut, rice, wheat, cowpea and 'jowar'. With every food there were four different pre-treatment feeding methods, namely, (*i*) the caterpillars were reared on crushed groundnut mixed with yeast powder in the ratio of 1 : 30 parts of crushed food materials, (*ii*) reared on crushed food materials only, (*iii*) starved for 48 hours after feeding on crushed food mixed with yeast, and lastly, (*iv*) the caterpillars were starved for 48 hours after feeding on crushed food materials only. Twenty test insects reared on each of the five types of food and under four different types of treatments mentioned above were taken in cylindrical wire-gauze tubes (2" × 1·2") and were exposed to carbon disulphide at a concentration of 5 lb./1,000 c. ft. of space for 24 hours in an air-tight, cylindrical, iron bin. The fumigation was conducted at room temperature and humidity varying from 78-93° F. and 52-82% respectively. There were five replications in each of the treatments including the control.

It was observed that groundnut plays a definite part in the metabolism of *Corcyra* caterpillars which ultimately renders them more susceptible to carbon disulphide than other food materials. The comparative resistance or susceptibility of the caterpillars seem to depend on the chemical nature of the food. It was also found that with all the five foods tried *Corcyra* caterpillars reared on crushed food materials mixed with yeast powder were more susceptible, though insignificantly, than those reared on the same food without yeast. Generally speaking, starvation upto 48 hours before the fumigation increases the resistance of the above, reared both with and without yeast, to carbon disulphide. Greater mortality with than without food on the one hand, and the still further increase in mortality on the addition of yeast to the food tends to indicate that the increase in insects' inherent resistance due to increased vitality is not so much as increase in activities like respiration leading to greater intake of the fumigant. Lack of food, among other things, decreases the rate of respiration. Consequently, the intake of the fumigant will be less as a result of which the mortality of the insect will also decrease. Prolonged starvation will decrease the vitality and might bring about greater mortality of the pest. Further studies will be continued.

Grateful thanks are due to Dr. E. S. Narayanan for his kind help in the above studies.

Ind. Agric. Res. Inst., New Delhi, *February* 4, 1955. SNEHAMOY CHATTERJI.

1. Sun, Yun Pei, *University of Minnesota Agri. Exptl. Station Techn. Bull.*, 1947, **177**, 104.

CHROMOSOME NUMBERS IN SESBANIA SPECIES

A STUDY of the chromosome numbers of four Sesbania species, namely, *Sesbania speciosa*, *Sesbania sesban*, *Sesbania sericea*, obtained from Indonesia and *Sesbania macrocarpa* from the Indian Agricultural Research Institute, New Delhi, was undertaken. The somatic numbers of these species have been determined from actively growing root tips and are given in Table I. The chromosome counts are based on the maximum number of metaphase plates.

TABLE I

Sesbania species*	$2n$	Authors
S. sesban ..	12	Jacob, 1941
S. speciosa ..	12	do
S. macrocarpa ..	12	Present count
S. sericea ..	24	do

* Except *S. macrocarpa*, the rest are suitable as green manure crop.

The chromosome number in the genus *Sesbania* Pers. was first reported by Kawakami.[1] He reported the haploid number of *Sesbania aculeata* as 16. But Haque[2] and Sampath,[3] while working on the same species reported the diploid number as 24. Jacob[4] while studying the genus Sesbania reported the diploid number of *Sesbania speciosa* and *Sesbania sesban* as 12 each. The present counts confirm the chromosome number of *Sesbania speciosa* and *Sesbania sesban*. As far as we are aware, the chromosome numbers of *Sesbania macrocarpa* and *Sesbania sericea* were not reported on earlier.

From the present work and that reported by earlier workers, it would seem that the basic number of the genus Sesbania is 6.

Further cytological studies of species of Sesbania are in progress.

Govt. Main Agril. Expt. Station, Himayetsagar, Hyderabad-Dn., *March* 16, 1955.

M. S. PAWAR.
S. A. KULKARNI.

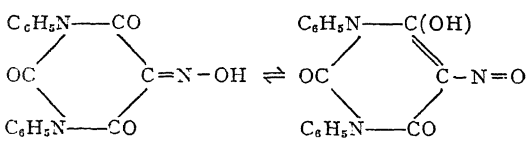
1. Kawakami, J., *Bot. Mag. Tokyo*, 1930, **44**, 319, 28.
2. Haque, A., *Curr. Sci.*, 1946, **15**, 78 ; 287.
3. Sampath, S., *Ibid.*, 1947, **16**, 30.
4. Jacob, K. T., *Bibliogr. Genetica* (*Graventage*), 1941, **13**, 225.

METALLIC COMPLEXES FORMED BY DIPHENYL-VIOLURIC ACID

DIPHENYL-VIOLURIC ACID has been found to form complex compounds with many metals. The compounds which are highly coloured, were obtained by addition of concentrated solutions of soluble salts of the metals in water to saturated aqueous solutions of the ammonium salt of diphenyl-violuric acid. The ammonium salt was obtained by dissolving diphenyl-violuric acid in ammonium hydroxide in which it dissolves readily. The solution on concentration on a water-bath, deposited pink crystals of the ammonium salt. The ammonium salt was found to be soluble in water.

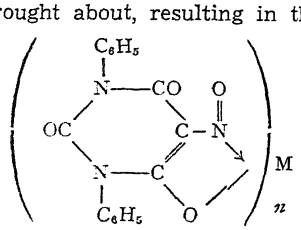
Diphenyl-violuric acid was obtained by the action of nitrous acid on 1 : 3 diphenyl-barbituric acid, synthesized by the action of diphenyl-urea on malonic acid in presence of chloroform solution of phosphorus oxychloride.

The metallic salts of diphenyl-violuric acid are probably internally complex compounds. The acid molecule in its nitroso-enolic form contains a replaceable hydrogen atom, which can be replaced by metal atoms during salt formation.



Oximino-ketonic form Nitroso-enolic form

On the other side, the nitrogen atom of the nitroso group, can combine with the metal atom by co-ordination, and ring closure can thus be brought about, resulting in the formation of inner complexes. The compounds can be formulated as in the above formula.



In the above general formula, 'M' represents the metal atom whose valency is *n*.

The properties of the salts are given in Table I. The empirical formula in each case was derived as a result of careful analyses of percentage of metal and percentage of nitrogen.

TABLE I

Properties of salts

Compounds*	Colour in solid state	Decomposition temp. °C.	Absorption maxima in acetone in *mμ*
CuD†	Emerald green	240	652
CuD_2	Leather brown	175	473
AgD	Pale violet	160	560
AuD_3	Orange brown	153	485
CaD_2	Pale pink	159	520
BaD_2	Deep pink	>290	540
HgD	Pale pink	180	515
AlD_3	Crimson	115	550
CeD_3	Yellowish brown	>290	450
TiD_4	Grey	95	420
ZrD_2	Light yellow	>290	450
ThD_2	Brownish	>290	475
SnD_2	Pink	140	520
PbD_2	Flesh coloured	190	515
CrD_2	Greenish blue	153	645
UO_2D_2	Sulphur yellow	220	420
FeD_2	Indigo blue	220	630
FeD_3	Dark bluish green	172	655
CoD_2	Brown	202	485
NiD_2	Brown	>290	498
PtD_4	Pale pinkish brown	214	510
BiD_3	Salmon	>290	525
Cu_3D_4‡	Olive green	..	650

*D = Diphenyl violurate; † (with excess of $CuSO_4$)
‡ From boiling solutions using excess of $CuSO_4$.

Full details of the above investigations will be published elsewhere.

Chemistry Dept., University of Delhi, Delhi-8, *February* 24, 1955.

R. P. SINGH.

A NEW ORGANIC REAGENT FOR GRAVIMETRIC ESTIMATION OF COPPER

A LARGE number of reagents have been used for various types of estimations in recent times. In the case of copper, α-benzoinoxime, quinaldinic acid, salicylaldoxime, etc., have been used with success. It has been found that diphenyl thio-violuric acid can be used equally satisfactorily for this purpose.

The reagent, diphenyl thio-violuric acid, was used in the form of its ammonium salt. The preparation of the acid is similar to that of diphenyl violuric acid described in an earlier note.[1]

The ammonium compound was then dissolved in warm water and filtered if necessary and the clear filtrate (about 0·8% solution of the ammonium salt) was used for the estimations. On adding an excess of the aqueous solution of the ammonium salt to a solution of a copper salt, the latter is precipitated in the form of a complex.[2]

Exact conditions for the estimation of copper by the gravimetric method have been investigated. It was found that copper can be quantitatively estimated by adding an excess of the reagent solution between the pH range of 7·2-8·0. As a result of ten estimations within this range of pH, the average error came to about 0·3%.

The conditions for the quantitative precipitation of copper in presence of other cations are under investigation, full details of which will be published elsewhere.

Dept. of Chemistry, R. P. SINGH.
University of Delhi,
Delhi-8, *February* 24, 1955.

1. Singh, R. P., *Curr. Sci.*, 1955, **24**, 208.
2. Ghambhir, I. R. and Singh, R. P., *Proc. Ind. Acad. Sci.*, 1946, **23A**, 330.

OCCURRENCE OF SCOLYTID BEETLE ON STORED SWEET POTATOES

APART from *Cylas formicarius*, Fb. there appears to be no record of any other insect doing serious harm to stored sweet potatoes in this country. Recently the author came across a species of shot hole borer, *Scolytidæ*, causing considerable damage to stored tubers of sweet potato, which were part of a consignment purchased from the local market at Coimbatore and kept under observation at the insectary. The specimens were sent to the Commonwealth Institute of Entomology, London, and also to the Forest Research Institute, Dehra Dun, where it was identified as a species of *Stephanoderes* of the family *Scolytidæ*. As the insect is found to be a new pest on sweet potato, the following preliminary observations are recorded on its life-history and habits.

The adult is a dark brown beetle measuring about 1·9 mm. in length. Both the adults and the grubs of this beetle bore through the contents of fresh tubers converting the same into a powdery mass in due course. A heavily infested tuber shows a circuitous system of tunnels harbouring numbers of the beetle in various stages of development. The damage by this beetle is distinguishable from that of *Cylas formicarius*, Fb., in that the tunnels are very narrow and filled up with a powdery stuff, whereas in the latter case the tunnels are distinctly larger and are also badly stained with excrement. Another characteristic symptom of the damage by this Scolytid beetle is the ejection of powdery material through the bore-holes by the adults as noticeable in the case of other Scolytid beetles, which is not found in the case of the weevil damage.

As regards the life-history of this beetle, the female lays eggs in irregular longitudinal tunnels excavated by it in the tissue. The eggs are laid in rows close together along both sides of the tunnel, each egg being packed tightly in place with powdery material. The egg is pearly white, oblong oval and measures, on an average, 0·6 mm. in length and 0·3 mm. in width. The eggs hatch in 5-7 days and the newly hatched larva, which is a whitish, legless grub with a pale brown head and measuring about 0·8 mm. in length, bores through the tissue in all directions and becomes full grown in 18-27 days. The full grown grub is whitish and subcylindrical with a harder light brown head capsule and much wrinkled body and measures 2·2 mm. in length. Pupation takes place in a cavity at the end of larval burrow. The pupa is naked and whitish in colour becoming slightly darker upon maturity and is about 1·9 mm. long. The pupal stage lasts for 5-7 days. The adult just after transformation is soft and light in colour. When fully developed they emerge out through holes bored through outer skins. Many individuals emerge through the same exit holes. The total life-cycle worked out with reference to 40 individuals ranged from 28-41 days. The longevity of the beetle for both male and female was found to range from 42-68 days under laboratory conditions. The egg-laying capacity varied from 71-158 eggs. The pest was not found in the field in any of the villages from where the tubers are brought to the local market.

The author's sincere thanks are due to Sri. K. P. Anantanarayanan, for valuable suggestions in preparing this note.

Division of Entomology, T. R. SUBRAMANIAN.
Agric. College & Res. Inst.,
Lawley Road P.O., Coimbatore,
February 8, 1955.

SEPTORIA LEAFSPOT OF *MANILKARA HEXANDRA*

Manilkara hexandra Dubard. (*Mimusops hexandra*) is an ever-green tree, the seedlings of which are used as root stock for grafting *Achras sapota* L. During January 1955, the leaves were found infected by a fungus causing leaf spots. On examination the fungus was found to be a species of *Septoria*. The symptoms of the disease and the characters of the causal fungus are described below.

Septoria hexandræ—Kandaswamy and Sundaram Spec. nov.

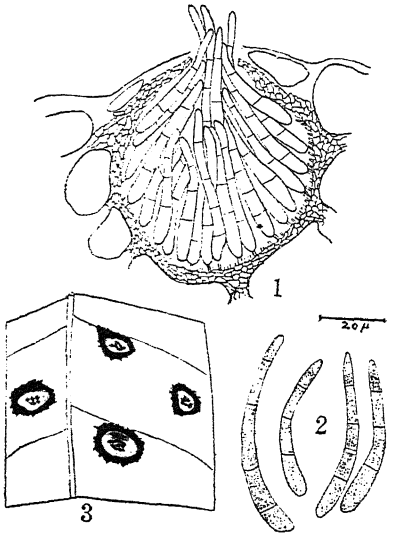


FIG. 1. Section through a pycnidium. FIG. 2. Conidia. FIG. 3. A portion of the leaf showing the spots (enlarged).

Spots numerous, amphigenous, round to irregular, cacoa brown in the middle with blackish purple margin, 2-5 mm.; pycnidia mostly on the lower surface, 5 or more in each spot, producing black slender thread-like spore horns up to 0·5 mm. long, subepidermal, immersed in the tissues, globose to subglobose, ostiolate, 62-93 × 57-77 μ with a peridium of 2-3 layers of light brown cells; pycnidiospores long, cylindrical, slightly bulged at the base, curved, septa 2-5, light brown, 50 × 3 μ (36-68 × 2-4·5), produced on very short stalks.

On living leaves of *Manilkara hexandra* (Sapotaceæ), Botanical Garden, Coimbatore, 29-1-1955, M. Kandaswamy and N. V. Sundaram.

The infection spots are very prominently seen by their blackish purple appearance with a cacoa brown centre. The colour is found more intensive on the upper surface. On the lower surface of the leaf in the middle of the spots are found black dot-like eruptions from which conical curved outgrowths made up of numerous conidia held together by the musilaginous excretion of the fungus are observed. The septation in the spores is visible only under the oil immersion lens. From the available literature there is no record of this fungus on this host genus and hence it is described as a new species.

Agric. College & Res. Inst., M. KANDASWAMY.
Lawley Road P.O., N. V. SUNDARAM.
Coimbatore, *February* 26, 1955.

WILT OF GRAM (*CICER ARIETINUM* L.) IN BIHAR

IN heavy soils of South Bihar, an unusual wilting of gram plants has been observed for the last two years. The disease was responsible for the death of 5-10% of the plants. In badly infected soils, the infected plants either did not tiller at all or there were only 1-2 tillers per plant. The infected plants appear sickly and die very slowly. The hyphal strands creep up the stems of infected plants and can be prominently seen in the early stages. Later brownish streaks with a few cinnamon-brown sclerotia may be found on the basal portion of the stems.

On isolation from the infected portions of the plants, mostly cultures of *Ozonium texanum* Neal and West, probably identical with var. *parasiticum* Thirumalachar where obtained. In sterile soils inoculated with the fungus, heavy mortality of gram seedlings resulted. Many of the seedlings failed to come out of the soil and a few which succeeded in so doing also died subsequently.

The pathogenicity of gram seedlings to the fungus (*Ozonium texanum*) has been confirmed by Shri B. P. Chakravarti during the course of further work on this disease.

Division of Plant Pathology, J. N. MISHRA.
Bihar Agric. Res. Inst.,
Sabour (Bhagalpur),
December 28, 1954.

REVIEWS

The Optical Properties of Organic Compounds. Second Edition. Enlarged and Revised. By A. N. Winchell. (Acad. Press Inc., New York), 1954. Pp. xviii + 487. Price $ 12.00.

This new edition of Winchell's Handbook contains optical data on more than 2,500 organic compounds, of which nearly a thousand have been added to the previous list. The compounds are arranged according to the method adopted in the fourth edition of Beilstein, so that organic chemists used to the latter will have no difficulty in looking up the data. In addition to the optical data a short summary of the morphological and X-ray data are also given (wherever available).

The main purpose of the book is to enable identification of the compounds by optical methods. For this purpose, two determinative tables are given based on the higher or the lower of the measured refractive indices. Two large diagrams are appended to the volume, which would be of great assistance in identification from the optical data.

The present volume is stated to contain all information published up to the end of 1952. Compilations of this type are of inestimable value, particularly since such data would be found only as part of a long paper and would not be indexed anywhere. The printing and get-up are excellent and the contents are remarkably free of errors, the only slip which the reviewer noted being the symbol $P2_1a$ instead of $P2_1/a$ for the space group of benzoin in p. 108. The volume is warmly commended to all libraries in physics and chemistry.

G. N. RAMACHANDRAN.

A Text-Book of Radar. Second Edition. Edited by E. G. Bowen. (By the Staff of the Radiophysics Laboratory, C.S.I.R.O., Australia), 1954. Pp. xiii + 617. Price 45 *sh.*

This is practically a reprint of the first edition which was published in Australia in 1947. The last three chapters, dealing with practical applications, have however been rewritten. The military applications have been compressed, while a more detailed account is given of the civil uses. A short account is also added regarding other applications in physics, *e.g.*, in ionospheric research, in the study of meteors, in meteorology, in radio-astronomy and in microwave spectroscopy. It is interesting to note that some of the most accurate values for the velocity of light have been obtained by means of Radar.

The chapters in the book are contributed by various members of the staff of the C.S.I.R.O. In spite of this, the contents have been well edited, and the volume can be used as a regular text-book by post-graduate and research students. The fundamentals are treated in good detail and numerous references are given to the original literature. Physicists and engineers who wish to keep abreast of the recent developments in the region of microwaves will find this to be an excellent book for reference.

Mechanism of Polymer Reactions—High Polymers, Vol. III. By G. M. Burnett. (Interscience Publishers, Inc.). Pp. xv + 493. Price $ 11.00.

The original volume 'High Polymeric Reactions' by Mark and Ruff was published at a time when the kinetics of condensation and addition polymerization was not completely understood. In the past decade or so, high polymer chemistry has taken dramatic strides and a full analysis of radical polymerization reactions and evaluation of rate constants of the individual steps in the chain process have been achieved. This new edition contains a wealth of data and information to completely replace the old one.

The first two chapters on general kinetics and experimental methods in radical polymer reactions are brief but interesting. The general principles and nature of the addition reactions and their kinetic analysis, are elucidated in the next two chapters. The chapters on gas phase and homogeneous liquid phase polymerization and the evaluation of rate constants in respect of various monomers contain information nicely summarised for a high polymer research chemist. Copolymerization and heterogeneous liquid phase polymerizations as well as ionic and condensation polymerizations receive treatment which might appear scanty, but nevertheless modern and full.

An account of the kinetics of radical depolymerization processes has been given for the first time in this book. Starting with a simple degradation reaction, hydrolytic

degradation of cellulose, the complete kinetic analysis of degradation of cellulose and radical chains of various monomers has been dealt with.

The mathematical treatment throughout the book is very detailed and embodies the full significance of the complexities of chain reactions. The topics of branching and cross-linking are slightly touched upon. With such valuable and up-to-date information the book will be of special value to physical chemists and particularly to high polymer research chemists.

M. SANTHAPPA.

Electromagnetic Theory. By V. C. A. Ferraro, University of London. (The Athlone Press), 1954. Pp. viii + 555. Price 42 *sh.*

This is admirably suited to be a text-book for students taking Electromagnetic Theory as their special subject for the Honours or Masters Degree in Mathematics. Part I deals with the basic principles of electrostatics and electrodynamics. Part II on boundary-value problems is concerned with the mathematical theory of determining potential distributions given specific boundary conditions, in particular the use of spherical and spheroidal harmonics. Part III contains a discussion of electromagnetic phenomena, with particular stress on the essential mathematical aspects, leaving out topics of purely physical interest such as the electrodynamics of moving media and the electron theory of dispersion.

The treatment is throughout very clear and elegant and the printing leaves nothing to be desired. Vector notation has been used systematically, and the first chapter covers those portions of this subject which are needed later. Each chapter has, appended to it, a large number of examples, and these greatly add to the usefulness of the book as a text-book. Although written specifically for the mathematician, it will also serve well as a reference book for physicists and engineers.

Mass Balancing of Aircraft Control Surfaces. By Templeton. (Chapman & Hall), 1954. Pp. x + 241. Price 35 *sh.*

A good amount of work has been done on the subject of mass balancing of aircraft control surfaces, and a need for a systematic presentation of the published data in the form of a text-book has long been felt. The monograph published under the authority of the Royal Aeronautical Society can easily meet the requirements of a text-book on that subject.

Part I of the book provides in a lucid style an understanding of the basic principles employed in the application of mass balancing to prevent flutter of aircraft control surfaces. Part II of the book gives a historical review of the work done in Britain on that subject with additional chapters on design requirements for mass balancing and the procedure adopted in practice. Another chapter gives the various methods adopted for mass balancing. Part III gives a short note on the possible future developments and discusses the limitations in and alternatives for mass balancing.

Unfortunately the monograph is limited purely to British work on the subject. Yet it is adequate for the requirements of a text-book for a Graduate in Aeronautical Engineering. The recent developments on the subject in the United States of America could have been added in Part III. In spite of this limitation, the book, because of the good presentation of the subject-matter, should be welcome to all those engaged in Aeronautical Engineering either in industries or educational institutions.

N. SRINIVASAN.

Chemical Pathways of Metabolism, Vol. I. Edited by D. M. Greenberg. Pp. xi + 460. Price $ 11.00; Vol. II: Pp. x + 383. Price $ 9.50.

Intense research activity in biochemistry in various directions has necessitated in recent years the publication of books containing review articles, which aim at integrating the work carried out on different aspects of one and the same problem. The efforts of Dr. Greenberg in editing two such volumes dealing with chemical pathways of metabolism may be considered as very praiseworthy indeed, particularly in the context of the wide variety of subjects covered in this extensive field of biochemical investigation. The topics which have been dealt with in Volume I are, Free energy and metabolism, by A. B. Pardee; Enzymes in metabolic sequences, by D. E. Green; Glycolysis, by P. K. Stumpf; The tricarboxylic acid cycle, by H. A. Krebs; Other pathways of carbohydrate metabolism, by S. S. Cohen; Biosynthesis of complex saccharides, by W. Z. Wassid; Fat metabolism and acetoacetate formation, by I. L. Chaikoff and G. W. Brown Jr.; and Sterol and steroid metabolism, by K. D. Fukushima and R. S. Rosenfeld. Three of the eight chapters in the second volume dealing with carbon catabolism of amino acids, synthetic processes involving amino acids and the

metabolism of sulphur containing compounds have been written by the editor himself, while the remaining five are by (*i*) P. P. Cohen on nitrogen metabolism of amino acids, (*ii*) H. Borsook on enzymatic synthesis of peptide bonds, (*iii*) M. P. Schulman on purines and pyrimidines, (*iv*) L. A. Heppel on nucleotides and nucleosides, and (*v*) S. Granick on metabolism of leme and chlorophyll. Though some of these articles are short and the literature covered in the first volume is only up to the middle of 1953, the treatment of the different topics is uniformly good. Special mention may, however, be made of the very valuable contribution of Krebs on the tricarboxylic acid cycle, and the comprehensive review on the biosynthesis of complex saccharides by Hassid. Granick has also dealt in great detail on the metabolic studies of leme and chlorophyll.

An error has crept in on p. 165 in the second volume, wherein it is stated that the structural formula of coenzyme A is shown in page 149, whereas no formula of any kind is given in the page referred to. In the chapter on the metabolism of amino acids, the work of A. Butenandt and his associates could have been described in the section dealing with tryptophane metabolism. However, subjects like glycine-serine and other interconversions, the biosynthesis of branched chain amino acids and the aromatic amino acids have been written by Dr. Greenberg in an elegant fashion and constitute a veritable mine of useful information. One may perhaps take exception to the practice of some of the authors quoting from proceedings of learned societies since such references are not easily available for consultation and more often do not give much detailed information. However, in spite of these minor drawbacks, the volumes as a whole are excellent in their scope and content, and very well got up. They should help biochemists all the world over in their investigations of the several pathways of metabolism. To the teacher in biochemistry, the two volumes are invaluable for his lectures on the various aspects of metabolism.

P. S. Sarma.

The Production and Use of Power Alcohol in Asia and the Far East. (The Economic Commission for Asia and the Far East, United Nations), 1954. Pp. 445. Price not given.

The above is a report on the Regional Seminar on the production and use of power alcohol held in Lucknow from 23rd October to 6th November 1952. It covers the deliberations and discussions of the participating experts in the Seminar, and will be of immense use to specialists and industrialists associated with power alcohol.

Liquid-Liquid Extraction. By L. Alders. (Published by Elsevier Publishing Company, Amsterdam), 1955. Pp. x + 206. Price 32 *sh.*

The book provides systematic and detailed knowledge of the theory of liquid-liquid extraction and describes the various methods of investigation concerned with liquid-liquid extraction processes. A survey is given of the principal extraction procedures, *viz.*, cross-current extraction, two solvent extraction and extraction with reflux. Experimental methods have been suggested for determining the phase equilibrium data which are necessary for the design calculations. The author has not dealt with any special features of the Chemical Engineering side of liquid-liquid extraction, nor is any commercial equipment described. Information on such subjects, however, is already available in "Liquid Extraction" by R. E. Treybal, "Absorption and Extraction" by T. K. Sherwood and R. L. Pigford, etc. The author has treated this specialised subject in the simplest possible manner and the book offers a great wealth of information. It is an excellent manual of technique for all investigators concerned with liquid-liquid extraction and will be very useful to all chemical investigators in research institutions and industries interested in this field.

G. S. Laddha.

Books Received

The Relation of Immunology to Tissue Homotransplantation. By J. M. Converse and 34 others. (*Annals of the New York Academy of Sciences,* Vol. 59, Art. 3). Pp. 190. Price $ 4.00.

Ionizing Radiation and the Cell. By L. F. Nims and 22 others. (*Annals of the New York Academy of Sciences,* Vol. 59, Art. 4). Pp. 200. Price $ 4.00.

Protective Current Transformers and Circuits. By P. Mathews. (Chapman & Hall), 1955. Pp. xv + 253. Price 36 *sh.*

Precast Concrete. By Kurt Billig. (Macmillan & Co.), 1955. Pp. xvi + 341. Price 32 *sh.*

Progress in Nuclear Physics, Vol. 4. Edited by O. R. Frisch. (Pergamon Press), 1955. Pp. vii + 379. Price 70 *sh.*

Technical Publications—Their Purpose, Preparation and Production. By C. Baker. (Chapman & Hall), 1955. Pp. xiii + 302. Price 36 *sh.*

Integers and Theory of Numbers. (Scripta Mathematica Studies, No. 5). By Abraham A. Fraenkel (Scripta Mathematica, 186th Street, Amsterdam Avenue, New York 33, N.Y.), 1955. Pp. 102. Price $ 2.75.

Introductory Applied Physics. By Norman C. Harris and Edwin M. Hemmerling. (McGraw-Hill), 1955. Pp. viii + 729. Price $ 6.75.

Some Beautiful Indian Trees. By E. Blatter, Water S. Millard and W. I. Stearn. (Bombay Natural History Society, 114, Appollo Street, Bombay), 1954. Pp. xv + 165. Price Rs. 20 or 30 *sh.*

Aromatic Compounds—Chemistry of Carbon Compounds, Vol. III. Edited by E. H. Rodd. (Elsevier Publishing Co.), 1954. Pp. xxiv + 686. Price not given.

Advances in Geophysics, Vol. 2. Edited by H. E. Landsberg. (Academic Press, Inc.), 1955. Pp. x + 286. Price $ 7.50.

SCIENCE NOTES AND NEWS

Preservation of Palm Juice

P. S. Murthi and C. J. Dasa Rao, Department of Chemical Technology, Andhra University, in the course of a communication to the *J.S.I.R.* (1955, 14 A, 250) observe that the usual method followed by the tapper consists in adding lime to the earthen pots before they are used for collecting the juice and after 12 hr., the juice is removed from the pot for further processing. The juice collected usually starts fermenting after an hour or two. The amount of lime employed by the tapper varies from 0·04 to 0·12% of CaO on the weight of juice. With a view to determine the optimum amount of lime to be employed, experiments were carried out using different concentrations of lime. It was found that addition of lime in a concentration of 0·55% CaO on the weight of fresh juice prevented it from fermenting. The juice remained sweet for 40 hr. and there was no fall in its sucrose content. Higher concentrations of lime had no additional advantage.

Polyspory in *Lantana camara* L.

S. L. Tandon and P. N. Bali, Department of Botany, University of Delhi, writes as follows: In addition to the normal tetrads, 5-10 spores per pollen mother cell were also present in the naturally existing triploid of *Lantana camara* L. Polyspory in this case has been found to be due to irregularity in chromosome distribution and the occurrence of lagging chromosomes resulting in a high degree of sterility. The environmental factor as the cause of polyspory has been ruled out as the diploid in which the distribution of chromosomes was regular and which did not show polyspory was growing just by the side of the triploid showing polyspory.

Models of Molecular Structure

Many research workers have been aware of the value of the space-filling atomic models developed by G. S. Hartley and C. Robinson at the Maidenhead Laboratory of Courtaulds, Ltd. These models are now available commercially from the firm of Griffin and Tatlock (Kemble Street, Kingsway, London, W.C. 2). Primarily designed for research, where accurately made models are required from which quantitative deductions of molecular geometry can be made, the models are also eminently suitable for lecturing purposes. Important contributions to peptide and protein chemistry have already been made with the aid of these models. It is likely that their application in other fields will be equally fruitful.

Occurrence of Cistanche Species on *Salvadora persica*

R. A. Patel and R. M. Patel, Institute of Agriculture, Anand, Bombay, state that besides the occurrence of the root parasites *Crenata*, *Schweinfurthii* and *Ramosa* on the cultivated as well as on wild plants, recently a parasite *Cistanche tubulosa* Wight has been observed by the authors on the roots of *Salvadora persica* trees in the Kaira District of Bombay State. This would appear to be the first record of its occurrence in that locality.

Penetrometer

A new instrument which provides a method of measuring the compactness of underwater sediments without disturbing them has been developed at the University of Rhode Island

under contract with the Office of Naval Research and the Navy Hydrographic Office. The new instrument, a penetrometer, consists of a steel tube with a probe on the end which is driven through a hollow shaft into the bottom by a motor and a mechanism which measures and makes a permanent record of resistance at depths up to 200′. The working mechanism is mounted on a 5-foot frame resembling a bell buoy. It weighs 145 lb. without the lead weights which hold it in position under water. The motor which drives the probe is equipped with a water-tight cover which can be pressurized. In addition to probing the ocean bottom, the penetrometer may be used on land as a soil-mechanics instrument for highway planning and foundations.

U.S. Atomic Energy Reports on Microcards

All unclassified reports of the United States Atomic Energy Commission are being put on microcards and made available as widely as possible. Some 9,500 unclassified reports have been published since the beginning of the Commission's operation, and more are being issued at the rate of 1,800 reports a year.

Most of the Commission's reports fit on one card, and it is estimated that the cost of each card will be about 20 cents. To subscribe for all the reports published to date, therefore, would cost approximately $2,000. Reports issued currently, about 1,800 per year, would cost $400 yearly. Orders will be accepted for reports on specific subjects, as well as for individual reports, but the latter will cost about 50 cents per microcard, due to the extra handling costs involved.

Symposium on *Rauwolfia serpentina*

A symposium on *Rauwolfia* will be held under the auspices of the Pharmaceuticals and Drugs Research Committee in September 1955. The venue of the symposium will be announced later. The following aspects of *Rauwolfia* will be discussed: (*i*) Botany and Pharmacognosy, (*ii*) Chemistry of active principles, (*iii*) Pharmacological action of active principles, (*iv*) Therapeutic uses, and (*v*) Manufacture and standardization of *Rauwolfia* preparations.

A Marine Bacteriophage

One of the main difficulties in the study of marine bacteria, and particularly of those types which constitute the flora of fresh and spoiling fish, is that of identification and classification. This is due to the negative results given by these bacteria in most common biochemical tests. In the course of a communication in *Nature* (1955, **175**, 690), R. Spencer describes the use of a bacteriophage which might help with this difficulty. Attempts were made to isolate bacteriophages active against certain marine bacteria associated with fish, and particularly against certain luminous bacteria probably identical with *Photobacterium phosphoreum* (*Bacterium phosphoreum* Bergey). These luminous bacteria have been shown by various workers to constitute a considerable part of the flora of many species of fish.

Height of Mount Everest

The height of Mount Everest has long been a subject of much discussion. Its accepted height is 29,002′, but several other values have also been quoted from time to time. *Technical Paper No.* 8 of the Survey of India deals with the work undertaken by the Geological Survey of India during 1952-54 for determining the height of Mount Everest accurately. The new value for the height of the peak, obtained on analysis and reductions of new data from these investigations, is 29,029′ which, it is hoped, is not likely to be in error by more than 10′.

Pole of Rotation of Venus

It is reported by Gerard P. Kuiper, associated with the University of Chicago's Yerkes Observatory (Wis.) and the McDonald Observatory (Tex.), that the pole of rotation of Venus is tipped at an angle of 32° to its path, compared with the earth's 23·5°. Further, Kuiper's observations indicate that a day on Venus, one rotation upon its axis, is not almost a year of earthly time, as some text-books estimate, but probably not more than a few weeks. He believes that this rapid rotation is shown by the daily changes that occur in the dark and light bands with which the planet is covered. The bands, usually three bright ones and three dark ones, are thought to be parallel to the equator of Venus.

Dr. K. S. Krishnan

Dr. K. S. Krishnan, Director, N.P.L., New Delhi, who presided over the deliberations of the International Advisory Committee for Scientific Research—the programme of Natural Sciences (UNESCO) at Pallanza, has been elected the Chairman of this Committee.

New Director for European Centre for Nuclear Research

Dr. Felix Bloch of Stanford University, who a few months ago accepted the Directorship of

the European Centre for Nuclear Research in Geneva, has asked to be relieved of his duties there. He will be succeeded by Dr. C. J. Bakker, Professor of Physics at the University of Amsterdam, who is at present a member of the organization's directorate and a Director of the Synchrocyclotron Division.

Award of Research Degree

The Annamalai University has awarded the Ph.D. Degree in Zoology to Sri. Joseph Jacob for his thesis entitled "Some Aspects of Experimental and Comparative Embryology Molussca (Studies in the Cytology of Melaniidæ with special reference to Parthenogenesis and Polyploidy)".

The University of Calcutta has awarded the Ph.D. Degree to Shri A. G. Datta for his thesis entitled "Action of Some Antimalarial Drugs on Enzymes of Tricarboxylic Acid Cycle" and to Shri Achintya Kamal Sen for his thesis entitled "8-Aminoquinolines as Possible Antimalarials".

Cell Division through Chemical Activation

A chemical that makes cells divide has been isolated in pure crystalline form by a research group at the University of Wisconsin. Carlos Miller and Folke Skoog of the Botany Department, and Malcolm von Saltza and F. M. Strong, of the Department of Biochemistry, have named the compound 'kinetin'. It has a molecular weight of only 215, and its chemical formula indicates that the molecule contains 10 atoms of carbon, 9 of hydrogen, 5 of nitrogen, and 1 of oxygen. Kinetin is obtained from desoxyribonucleic acid.

When just a trace of the new substance is added to culture mediums for plant tissue cells that are long past the growth period, the cells divide and new cells continue to be formed indefinitely so long as kinetin is in the medium. The signs of growth usually show up within 3-5 days. When the rejuvenated tissues are placed in another medium that lacks kinetin, they stop growing. In order that continuous growth occur, the hormone auxin must also be added to the medium. Similar effects of cell division have been obtained with extracts from both plant and animal sources, including herring sperm, calf thymus glands, brewer's yeast malt and coconut.

Hindustan Machine Tools Factory

The Hindustan Machine Tools Factory at Jalahalli near Bangalore went into production recently. The 9-crore project is the result of a technical assistance agreement signed between the Government of India and Messrs. Oerlekon Machine Tool Works, Buehrle & Co., Zurihu, in April 1949. The Swiss firms are providing the technical 'know-how' of machine tool manufacture, equipment, jigs, tools and fixtures, duplicate patterns, operation schedules, etc., and have also sent out technical experts and keymen to enable the factory to be set up.

The factory is at present engaged in the manufacture of precision type machine tools commencing from 8½" centre lathes and will gradually take up other items like large type lathes and milling machines in different stages. The target of 400 lathes per year is expected to be reached within a period of three years.

Organic Chemistry Symposium of the ACS

The Fourteenth National Organic Chemistry Symposium of the American Chemical Society was conducted under the auspices of the Organic Chemistry Division of the ACS, in the Purdue University, Lafayette, Indiana, starting from June 13. Over a thousand chemists from all over the U.S.A. and a few from other countries attended the symposium. The various papers presented in the symposium covered the more recent advances in organic chemistry. The subjects discussed were: Stereospecific syntheses by Gilbert Stork, Stereospecific and non-specific elimination reactions by Stanley Cristol, Mechanism of chromic acid oxidation of alcohols by Westheimer, New small ring compounds by John Roberts, Chemistry of medium-sized ring compounds by Aurthor Cope, Transannular nitrogen-carbonyl interactions by Nelson Leonard, Recent developments in the chemistry of free radicals in solutions, and Stereochemistry of some replacement reactions in inorganic complexes. Besides, some papers of biochemical interest such as Total synthesis of steroids, Hormones of the posterior pituitary glands, and Photosynthetic carbon cycle were also presented. Prof. Roger Adams was the guest speaker to give the "Reminiscences", and he gave a brief picture of the story of evolution of modern organic chemistry.

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NATIONAL RESEARCH DEVELOPMENT CORPORATION OF INDIA

WITH the establishment of a chain of national laboratories and the quickening tempo of research, the gap between research and development tends to become a wide one, and the need was being felt for sometime for a special organisation to bridge this gap. The Council of Scientific and Industrial Research had proposed the setting up of a National Research Development Corporation of India for this purpose, on lines similar to those in the United Kingdom and Canada. The recommendation was supported by the Planning Commission, and with the approval of the Government of India, the Corporation was established in December 1953, the following constituting the first Board of Directors: Shri Kasturbhai Lalbhai (*Chairman*), Lala Shri Ram, Dr. S. S. Bhatnagar, Dr. V. A. Sarabhai, Shri P. A. Narielwala, Shri M. D. Chaturvedi and Shri M. S. Bhatnagar.

The main function of the Corporation is to stimulate development of patents and inventions arising out of researches conducted in research institutions financed out of public funds, and where feasible, of patented inventions from private individuals also when such development is in public interest. The Corporation has no statutory powers of compulsorily acquiring patents and inventions; it can only do so by agreement and negotiation.

The Corporation has been functioning for more than a year, and the first annual report which has been published gives details of its work during the period. A major concern of the Corporation during this period has been to settle the preliminary details and arrangements for the acquisition of patents and inventions for developmental purposes. It has been decided that work in connection with the exploitation of Government-owned patents as

well as that relating to the development and exploitation of CSIR patents and inventions be transferred to the Corporation. (Patenting of inventions and renewal of patents however continues to be the responsibility of the CSIR.) During the year under review, the assistance of the Corporation has also been sought by the Central Laboratories for Scientific and Industrial Research, Hyderabad (Dn.), Indian Lac Research Institute, Ranchi, College of Engineering and Technology, Calcutta, as well as by a number of private inventors.

Development of inventions by the Corporation is secured by arranging large-scale trials in co-operation with industry, or licensing out patents and inventions to industrialists for large-scale production depending upon the nature of the work and the stage to which laboratory investigations have been pursued. The reports received from research institutions are carefully scrutinised to examine the stage to which laboratory investigations have been conducted and decide whether further pilot or large-scale trials are indicated to develop the research work and establish its practical and economic possibilities.

In cases where large-scale trials at an industrial plant are necessary, as when the investigations have a bearing on industries already established in the country, the Corporation selects, in consultation with the research organisation concerned, the factory where the trials are to be conducted and settles with the firm details regarding expenditure on the conduct of the trials and the concessions which the firm is to receive in return for facilities afforded. A model developmental licence agreement to define the rights of the parties has been drafted and is entered into between the Corporation and the firm before trials are undertaken.

Where laboratory investigations are complete and no further pilot or large-scale trials appear indicated, a non-technical note is published and circulated to chambers of commerce, scheduled banks, insurance companies, directors of industries of States, associations of industries likely to be interested in the development of the process and a large number of prominent industrialists. Interested parties are encouraged to examine samples and comment on them. Such information as can be released in the preliminary stages is made available. Terms for the licensing of the process are negotiated, keeping in view the scope of its application, the likely demand and feasibility of arranging production at more than one centre. If a process has a limited application, exclusive licences may be issued. Where wider possibilities of application appear possible, zonal or non-exclusive licences are considered. In cases where the process is of a general application it may be allowed to be used by all interested parties.

Upto the end of the period under review, 177 inventions from various institutions were handled by the Corporation and 62 processes are under critical examination. Plans for the development of the Corporation include a Survey and Statistics Section with a view to (*i*) study the economic significance of researches reported for development and keep abreast of developmental trends; (*ii*) conduct an effective market research and a feasibility study for the promotion of products and processes; and (*iii*) examine and classify patents and information on processes and supply the National laboratories with references and information on all available processes and patents concerning any particular development. An Industrial Relations Section for more effective liaison between research and industry is also contemplated.

The Corporation has made a good beginning and it is to be hoped that it will play an increasingly important part in the development of our industrial methods.

RADIO WAVES FROM JUPITER

RADIO wave emission from the planet Jupiter has been detected by Dr. B. F. Burk of the Carnegie Institute, Washington D.C., and confirmed by workers in the Radiophysics Division, the Commonwealth Scientific and Industrial Research Organisation, Australia. The discovery is quite unexpected.

Dr. Burk's observations were made on a frequency of 22 megacycles a second, which corresponds with a wavelength of about 14 metres. It was by chance that the narrow field of view of the telescope—one and a half degrees wide—included Jupiter. Short bursts of radio emission of about one second duration were noticed, and for more than a month the movement of Jupiter was followed. The fact that the bursts are of short duration suggests a more or less localized origin, and the fact that they have been detected only on one day in three may be connected with the rotation of the planet, which has a "day" of 9 hr. 50 min.

BREAKS IN INDIAN SOUTHWEST MONSOON AND TYPHOONS IN SOUTHWEST PACIFIC

C. R. V. RAMAN

Regional Meteorological Centre, Bombay

ONE of the important features of the Indian southwest monsoon is the trough of low pressure which extends from northwest India to Orissa. The axis of this trough runs on the average from Hissar in the Punjab through Agra and Allahabad to the head of the Bay of Bengal in the mid-monsoon month of July. The winds are westerly to the south of the axis, while to the north, they are easterlies. This axis does not remain stationary, but it moves north or south of the normal position and affects the rainfall distribution over the country as it moves. Sometimes, the axis of the trough shifts north and lies possibly over the Himalayas. When this happens westerlies sweep across the Gangetic Plain and the easterly flow is totally absent. This is called by the Indian Meteorologists as a 'break[1] in the monsoon'. In such situations the rainfall is mostly confined to the foot of the Himalayas and is also heavy. There is a general decrease of rain over the rest of the country.

Malurkar[2] has concluded that the shift of the axis of the monsoon trough northwards may be taking place at a time when one of the stationary low pressure areas in West China or Chinese Turkestan gets accentuated. This accentuation may be partly due to the more southerly travel of extra-tropical disturbances than usual. He has also said that the travel of a low pressure area or 'pulse' south of the equator into the southwest Arabian Sea may give rise to a 'break' in the monsoon in the Indian area. Koteswaram[3] has mentioned that the westward movement of an upper 'low' at low latitudes across the Indian area is often associated with a 'break' in the south-west monsoon. Parthasarathi[4] has recently discussed some aspects of breaks in the monsoon during 1954.

In this note, an attempt has been made to trace the relationship between the 'breaks' in the southwest monsoon in India and the movement of depressions or typhoons in the southwest Pacific. The typhoon tracks published by the Royal Hongkong Observatory in their 'Meteorological Results—Part I', have been used in this study. The positions of depressions and typhoons mentioned in the note hereafter refer to 00 GMT. The axis of the monsoon trough in India has been traced from the daily wind distribution at 3,000' at 0200 GMT. The study covers the months of July and August in the six years, 1947-52.

A close correlation has been found to exist between the position of the axis of the monsoon trough and the position of typhoons in the China Seas. As depressions or typhoons in the southwest Pacific located between longitudes 110° E. and 140° E. crossed over to the north of Lat. 30° N., the axis of the monsoon trough over India moved into the Himalayas. Six specific instances in support of the above are given in Table I. It was seen that in five of these cases the axis of the monsoon trough moved to the foot of the Himalayas within a day of the depression or typhoon in the China Seas crossing to the north of Lat. 30° N.

TABLE I

No.	Date on which depression or typhoon in S.W. Pacific crossed to the north of Lat. 30° N. with position of the centre on that date	Date on which the axis of the monsoon trough over India at 3,000 ft. shifted close to the foot of the Himalayas
1	9-7-1947 (31·4° N., 130·3° E.)	9-7-1947
2	7-8-1947 (33·3° N., 138·2° E.)	7-8-1947
3	17-7-1949 (31·2° N., 129·8° E.)	18-7-1949
4	16-8-1949 (32·7° N., 130·0° E.)	20-8-1949
5	5-7-1951 (32·8° N., 136·9° E.)	6-7-1951
6	22-8-1951 (32·6° N., 124·3° E.)	23-8-1951

Only in the August 1949 instance (16th-20th), did the eastern end of the trough begin to shift northwards after the typhoon moved to the north of 33° N. After the typhoon moved to 36° N. the trough shifted into the Himalayas. The instance of July 1949 is very striking in that the trough on the 16th was occupying an unusually southerly position between 21° N. and 22° N. Within two days this trough moved into the Himalayas coinciding with the movement of a typhoon from 27·8° N. to 34·1° N. The break that set in on 23rd August 1951 lasted practically till the end of the month.

Two more instances of the axis of the trough having shifted to the Himalayas with the depression/typhoon heading towards Lat. 30° N. occurred during the periods 27th-30th July 1947 and 10th-15th August 1950. In these two instances full information regarding the typhoon tracks is not available.

There have been six cases when the axis of the monsoon trough did not shift to the hills even though depressions or typhoons in the China Seas have crossed to the north of Lat. 30° N. These instances occurred during the periods 5th-9th July 1948, 27th-29th July 1949, 18th-21st July 1950, 26th-29th July 1950, 18th-20th July 1952 and 16th-19th August 1952. It was, however, noticed that at about that time, conditions have either been unsettled in the North Bay of Bengal or depressions have been present in the Indian area.

Even with no depressions in the Indian area, a few instances have been observed when the axis did not shift to the Himalayas in spite of the depression/typhoon in the China Seas having crossed to the north of Lat. 30° N. The noteworthy feature in these cases is that at the same time there were other typhoons or depressions in the southwest Pacific itself at more southern latitudes than the ones that had crossed 30° N. Two such instances occurred during the periods 23rd-25th July 1949 and 13th-15th July 1952.

Besides the cases mentioned above, there have been only two other occasions of break in monsoon in the months of July and August in these six years which it has not been possible to associate with published typhoon tracks available to the author. It is not known whether there were any typhoons to the east of Long. 140° E. during the period which have had any association with these two cases of breaks. It may be mentioned that all the typhoons which have crossed 30° N. to the west of 140° E. during these six years have been considered in this note.

From the above evidence the following correlations would appear to exist between the 'break in the monsoon' over India and movement of depressions or typhoons in the southwest Pacific: (*i*) When a depression or typhoon in the China Seas crosses to the north of 30° latitude the axis of the monsoon trough shifts into the Himalayas; (*ii*) This break does not occur if simultaneously there is another depression or typhoon in the China Seas itself to the south of latitude 30° N. (*iii*) Unsettled conditions in the Bay of Bengal or a depression in the Indian area prevents the movement of the monsoon trough into the Himalayas even if a depression or typhoon in the China Seas has crossed 30° N. latitude.

The general circulation gives an easterly flow over the sub-Himalayan area above 4 km. during the months of July and August. Typhoons of the China Seas are intense systems which may affect the general circulation over a very wide belt. Hence it is probable that a typhoon near Long. 120° E., when it crosses to the north of Lat. 30° N. may affect the circulation westwards as far west as 80° E. and replace the prevailing easterlies by westerlies over the Indian area which lies to the south of the typhoon centre.

However, when there is a tropical cyclonic system in the Indian area itself, it is natural to assume that the far eastern typhoon is unable to replace the prevailing easterlies above 4 km. along the foot of the Himalayas by westerlies. Again, when there are two typhoons, one to the north of Lat. 30° N. and the other to the south of Lat. 30° N., their effect at the distant Indian latitudes may cancel out and under such a situation the prevailing easterlies over India may continue and the axis of the monsoon trough may not shift to the hills.

It is not contended that the typhoons in the China Seas are the only factor controlling the breaks in the Indian monsoon. Factors such as the unusual southward movement of the troughs in the westerlies further to the north of India may also have an influence on the occurrence of 'breaks'. This aspect of the problem is under investigation.

I am grateful to Dr. B. N. Desai and Mr. Y. P Rao for their guidance in this investigation I am also thankful to Dr. P. R. Pisharoty for going through the manuscript.

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ECTOPARASITES OF SOME BATS FROM INDIA

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OBSERVATIONS made on external parasites of bats from Bombay State and some other parts of India for the last three years show that Indian bats carry a rich fauna of ectoparasites, particularly Diptera and mites. Fleas and bugs have also been found in small numbers. Some of the parasites exhibit peculiar adaptations.

Stiles and Nolen[1] were the first to give a complete list of bat parasites then known. A reference to this list would show that comparatively few species of bat parasites have been carefully studied, particularly those from Indian bats. Of the pupiparous Diptera, the Nycteribiids and Streblids are exclusively parasitic on bats. A good deal of work has been done on their systematics and bionomics in some parts of the world but very little in India. Scott,[2] Bal and Ahmad[3] and Jobling[4] have studied about 18 species of Nycteribiids and 5 species of Streblids from Indian bats.

In all, 11 species of Nycteribiids, *viz., Basilia scotti, Penicillidia jenynsi* var. *indica, P. fletcheri, P. bombayensis, Nycteribia phillipsi, N. allotopa, N. parvula, Cyclopodia sykesii, C. ferrarii, Tripselia amiculata* and *Eucampsipodia hyrtli orientalis* have been found during this study. Of these *Basilia scotti* and *Penicillidia bombayensis* are new to science and *Eucampsipodia hyrtli orientalis* is a new subspecies.

Of the family Streblidæ, *Nycteribosca gigantea, N. amboinensis, N. modesta, N. taji* and *Raymondia joblingi* have been obtained during this investigation and of them *N. taji* and *R. joblingi* are new species.

Mites form another important group of external parasites which are encountered in large numbers on bats. Nothing is practically known about mites found on Indian bats excepting a few records by Oudemans[5] and Radford.[6] The bat mites are confined to the families Spinturnicidæ, Macronyssidæ (Liponyssidæ), Myobiidæ, Trombiculidæ, Lælaptidæ, Sarcoptidæ, Listrophoridæ and Spelærhynchidæ. Of these the members of the first five are represented in our collection from Bombay State.

Under the family Spinturnicidæ, *Ancytropus indica, A. kanheri, A. zelebori, Meristaspis lateralis, Spinturnix psi, S. euryalis orientalis* and *Periglischrus rhinolophi* are recorded for the first time from India. Of these *A. indica, A. kanheri* and *P. rhinolophi* are treated as new to science and *S. euryalis orientalis* as a new sub-species. The specimens of *A. indica* and *A. kanheri* were collected from *Rousettus leschanaulti,* Bombay, 1953, and *P. rhinolophi* and *S. euryalis orientalis* from *Rhinolophus rouxi,* Tulsi Lake Tunnel, Bombay, 1953.

The family Macronyssidæ is represented here by *Steatonyssus hubli, Ichoronyssus lingaraji* and *Hirstesia transvaalensis* and the first two species are new to science. *S. hubli* and *I. lingaraji* are obtained from *Pipestrellus ceylonicus chrysothrix,* Hubli, 1953, and *Taphozous longimanus,* Belgaum, 1954, respectively. *H. transvaalensis* from *Miniopterus fuliginosus,* Mahableshwar, 1953, agrees with the description given by Zumpt[7] but shows slight variations in the shape of the dorsal plate.

A record of *Neolælaps magnistigmatus* belonging to the family Lælaptidæ is made for the first time from India and it seems to be a common mite on flying-foxes.

Only three species of Myobiid mites have been collected from Bombay bats during the course of this investigation. Of these *Foliomyobia jamesonia* and *Neomyobia tulsi* are new species and *Foliomyobia barnleyi* has been recorded for the first time from India. *F. jamesonia* is found on *Rousettus leschenaulti* and *N. tulsi* on *Rhinolophus rouxi,* Bombay, 1954-55. *F. barnleyi* has been found to parasitise *Taphozous longimanus,* Bombay, 1952.

Of the two new species of Trombiculid mites reported here *Whartonia brennania* is separated from *W. perplexa* in possessing much broader scutum and chelicerae with strong teeth. The specimens of this species were obtained from *Hipposiderus bicolor fulvus,* Karla Caves, Bombay, 1953. *Trombicula hampi* collected from *Rhinophoma hardwicki,* Hampi (Mysore State) is differentiated from *T. laveri* by the different standard data of measurements and by the bases of the sensillæ, not being midway between the antero-lateral and postero-lateral setæ.

Jordan and Rothschild[8] and Mathur[9] have reported a few bat-bugs from India. *Cimex*

pipestrellus and *Cacodmus indicus* were the only two species taken from house-bats during this investigation.

Smit[10] has recorded a few species of fleas from *Rousettus* and *Pipestrellus* groups of bats and *Thaumapsylla breviceps orientalis* was collected from *R. leschenaulti*, Kanheri and Elephanta Caves, Bombay, 1953.

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NEW AETHER DRIFT EXPERIMENT

THE possibility of performing an experiment similar to that of Michelson and Morley, but using short radio waves in the place of light waves has been discussed in several letters in *Nature*. Among them, the experiment described by L. Essen (*Nature*, 1954, **173**, 734) has now been completed, and the results are reported by him in a recent issue of *Nature* (1955, **175**, 793).

A cylindrical cavity resonator (of length 16·866 cm. and diameter 8·075 cm.) was used to control the frequency of an oscillator at approximately 9,200 mc./s. The resonator was rotated continuously in a horizontal plane at a rate of about one turn per minute, the frequency of the oscillator being measured by comparison with a quartz standard at intervals of 45° during the rotation.

The theory of the method may be described in the following way. The cavity resonates when its length is a whole number of half wavelengths and the resonant frequency is given by

$$f = \frac{v}{\lambda} = \frac{nv}{2l}$$

where v is the phase velocity, λ is the wavelength of the resonator and n the number of half wavelengths. In this condition the time taken for the phase of the wave to travel to and fro between the end faces of the resonator is $1/f$. If now because of the earth's orbital motion a relative velocity q be postulated between the resonator walls and the medium of propagation within it, then just as in the optical case, this time becomes:

$$t_1 = \frac{2l}{nv}\left(1+\frac{q^2}{v^2}\right)$$

when the axis of the resonator is in line with the orbital motion and

$$t_2 = \frac{2l}{nv}\left(1+\tfrac{1}{2}\,\frac{q^2}{v^2}\right)$$

when it is at right angles to it. The resonant frequency and therefore the frequency of the controlled oscillator should thus vary by a fractional amount of $q/2v^2$ on rotation, there being two minima and two maxima for a complete rotation of 360°. The calculated frequency change is found to be 3 parts in 10^9 for the resonator and frequency employed, if the earth's orbital velocity is taken as 30 km./sec.

In the actual experiment, the observed change was of the order of 1 part in 10^{11}, *i.e.*, only about 1/300th of the expected change. Even this could be attributed to the changes of frequency produced by the presence of the earth's magnetic field.

It may be of interest to compare the above with the most recent optical results. In the precise determination made by Joos in 1930, the interference fringes were measured by a microphotometer, and it was concluded that there was a null result to $\pm 0{\cdot}001$ fringe or 0·3 per cent. of the expected displacement. Miller, however, who carried out the most extended measurements three years later, was critical of this result and published a paper in which he stated that there is a definite effect of about 8 per cent. of that anticipated. The present experiment suggests that Miller's conclusions cannot be accepted. The effect, if any, is shown to be not more than one-tenth of that reported by him, which must probably be ascribed to some systematic error.

PROF. GOBIND SINGH THAPAR*

DR. GOBIND SINGH THAPAR, Professor and Head of the Department of Zoology at the University of Lucknow, has recently retired from University service.

Dr. Thapar held various appointments in colleges in the Punjab, before he went to Europe. In 1927, after his return, he was appointed Reader in Zoology in Lucknow University and University Professor in 1951.

Dr. Thapar's abilities were nowhere better displayed than in the organisation of a flourishing school of research in helminthology at Lucknow where many students obtained their research degrees under his inspiring guidance and are now occupying important positions in academic life at Lucknow and elsewhere.

Prof. Thapar has been running a Helminthiasis Scheme of the Indian Council of Agricultural Research for 16 years at Lucknow, and has made valuable contributions to the morphology, systematics and life-histories of the helminth parasites of the domesticated animals of India. He was mainly instrumental for the foundation of the Helminthological Society of India in 1948, and the *Indian Journal of Helminthology*. He has been the moving spirit of the Society, and as the Editor of its Journal, has earned a great name for himself from helminthologists the world over.

Dr. Thapar has also donated all his personal collection of helminthological material consisting a large number of valuable types, co-types, etc., to the Heminthological Society of India, so that in due course, the Society can function as a Bureau for the supply of information on helminthology.

Dr. Thapar has been a President of Zoology Section of Indian Science Congress and a Fellow of various learned bodies, including the Zoological Society of India, the Indian Academy of Sciences and the National Institute of Sciences of India. Last November he was presented with a commemoration volume on his 60th birthday with contributions from the foremost helminthologists of the world.

Although Dr. Thapar has retired from the University, his activities in the scientific field have not ended. He has been pursuaded by the Society to continue to edit the *Indian Journal of Helminthology* and he has agreed to accept the Chief Editorship with the collaboration of an Editorial Board formed at his suggestion.

Zool. Survey of India, Calcutta-12. B. S. CHAUHAN.

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NATURE PROTECTION

SOIL, vegetation and fauna exist in delicate balance which has been interfered with by man time and time again. Untimely deforestation, for instance, causes erosion which may result in the devastation of whole areas; the use of insecticides may destroy parasites but also eradicates useful species, such as bees.

An exhibition recently opened at the Paris Natural History Museum depicts some of the consequences of man's untimely action. Entitled "Man against Nature", it has been organized with the support of UNESCO and the International Union for the Protection of Nature.

On UNESCO's request the Union has prepared a section of the exhibition devoted to the disturbance of natural balance, and illustrated by a dozen very striking examples. There is, for instance, the "conquest" of Australia by rabbits; twenty-four of these were brought into the country in 1859, and now millions of them are destroying both natural and cultivated vegetation. Jamaica is devastated by the mongoose—introduced with the object of destroying rats which were pillaging the sugar-cane plantations; but the mongoose also attacks domestic animals and destroys harvests. In Africa, the destruction of the leopard has resulted in an enormous increase of baboons and wild pigs which eat up the vegetation. In other countries, the eradication of the otter has brought about the disappearance of fish—for the otter destroyed diseased fish, thereby preventing the spread of epidemics.

The exhibition will remain open until the end of September 1955. The section devoted to the disturbance of natural balance will later form an independent exhibit which the International Union for the Protection of Nature will place at the disposal of members wishing to circulate it in their countries.—UNESCO.

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ON GÖDEL'S COSMOLOGICAL SOLUTION OF EINSTEIN'S GRAVITATIONAL FIELD EQUATIONS

Gödel[1] has obtained the curious solution:

$$ds^2 = a^2\left[dt^2 - dx_1^2 + \left(\frac{e^{2x_1}}{2}\right)dx_2^2 - dx_3^2 + 2e^{x_1}\,dt\,dx_2\right] \quad (1)$$

of the field equations in the relativistic theory of gravitation (with the cosmological term λ), *viz.*,

$$R_{\mu\nu} - \tfrac{1}{2}g_{\mu\nu}R + \lambda g_{\mu\nu} = -8\pi k T_{\mu\nu} \quad (2)$$

where

$$R = R_{\mu\nu}g^{\mu\nu}, \quad T_{\mu\nu} = \rho v_\mu v_\nu.$$

The above field equations are satisfied for the line element, if

$$\frac{1}{a^2} = 8\pi k\rho, \quad \lambda = -\frac{R}{2} = -\frac{1}{2a^2} = -4\pi k\rho \quad (3)$$

This solution obtained by Gödel is distinguished from the other known cosmological solutions of the field equations (2) in many interesting ways and has raised many new problems in the traditional treatment of the relativistic cosmology which are yet unanswered. In all the other solutions in relativistic cosmology that represent possible models of the universe, Weyl's postulate (*i.e.*, the paths of nebulæ lie in space-time on a bundle of geodesics diverging from a point in the distant past or future) and the postulate of homogeneity is assumed, in consequence of which

the space-time is split up into a time component orthogonal to the spatial group and a 'cosmic' or 'world-time' is defined contrary to the postulates of general relativity. Gödel has shown that the non-existence of one-parametric system of three-spaces orthogonal to the world-lines of matter shows rotational property in the universe. The arrow of time has no meaning in Gödel's solution and the notion of 'earlier-later' is to be abandoned in a cosmological sense.[2]

Earlier Gamow[3] has anticipated that rotating universe could be represented by anisotropic solutions of the field equations in relativistic cosmology. The significance of general rotation in the universe on the problems of cosmogony and in the determination of a true inertial frame for astronomical reference has been remarked also by Robertson.[4] The metric[1] is homogeneous and stationary, but not spherically symmetric. Einstein[5] had a belief that Mach's postulate (*i.e.*, the inertia depends upon the mutual action of bodies) is at least partially contained in the field equations. But Gödel has given an example of a solution that goes against Mach's postulate. According to the view-point of idealistic philosophy,[6] the universe is given as many times as there are possible distributions of matter. Accordingly, the question of the existence of multiverses in Gödel's solution makes physical sense. Weyl's postulate is seen not to be strictly obeyed in this solution. The light tracks are found to be of the type

$$x_1 = \gamma,\ x_2 = \beta t,\ x_3 = \alpha t$$

Gödel's solution does not give the red shift of the nebulæ and the problem whether Hubble's Law can be harmonised with a general rotation in the universe is still unsolved. In such a case a distinguished time direction may be related to the expansion of the universe and the concept of 'earlier-later' cannot be eliminated physically. Further details will be published elsewhere.

Thanks are due to Prof. V. V. Narlikar for his guidance and for suggesting the problem.

Dept. of Mathematics, S. Patnaik.
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ANOMALOUS REACTION OF WOOD ON PHOTOGRAPHIC EMULSIONS

In a previous note[1] in this journal, the author reported that the action of wood on different photographic emulsions did not run parallel to the photographic speed of the emulsion employed. It was then suggested, tentatively, that the inferior action observed in panchromatic and other high speed plates might be due to the presence in them, of dyes, which are introduced into them, to extend the range of their spectral sensitivity. This hypothesis has since been tested and confirmed by experiments.

In the present experiments eosin and erythrosin were used as sensitisers and the plates were half bathed in a very dilute solution of the dye in water (1 : 10,000) and air-dried.

The wood specimen, in this case the very active Salwood (*Shorea robusta*) was placed on the surface of the plate, and an exposure of 24 hours was given in total darkness as described in a previous note.[2]

The plate on development gave a picture of the wood, the intensity of which was perceptibly less in the dyed regions of the plate. A positive print of the picture obtained is reproduced in Fig. 1. The same effect was observed both

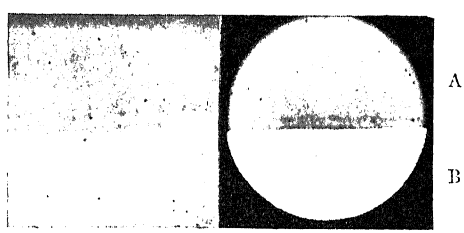


FIG. 1
Action of wood on photographic plate
A—Dye-sensitized region
B—Non-dye sensitized region

FIG. 2
Action of hydrogen peroxide on photographic plate
A—Dye-sensitized region
B—Non-dye sensitized region

Both figures are reproduced as positive prints of the original plates.

when the plates were dye-sensitized with eosin and erythrosin, and also when different types of plates were used.

The dyes used in the above experiments are reducing agents. Granting that the fogging action of wood is due to hydrogen peroxide[3] or some other form of organic peroxide, formed as a result of aerial oxidation, it stands to reason that the oxidising agents so formed act preferentially on the reducing dyes used to sensitize the silver halide emulsion. The dyes consequently act as a sort of a partial screen to the action of the fogging agents, thus account-

ing for the depressed activity in the regions covered by them.

The behaviour of hydrogen peroxide vapour itself towards a similar half dye-sensitized plate was studied separately, and has been found to be analogous to the action of wood. Such a plate when exposed to the vapour of hydrogen peroxide and processed in the usual way showed a distinctly lighter fog density in the regions bathed in the dye (Fig. 2). There is therefore a correlation between the action of wood and peroxdie in this regard.

This experiment not only shows that some of the dyes used for sensitizing emulsions have a stabilising influence on the emulsion in the sense that they render it more resistant to the action of fogging agents such as wood and peroxide, but also lends support to the peroxide theory advanced by Russel[4] to account for the action produced by wood and other substances on photographic emulsions.

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Pachaiyappa's College,
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UPPER LEVEL THERMAL TROUGHS AND LOWS IN THE DEVELOPMENT OF DUSTSTORMS AND THUNDERSTORMS OVER NORTH-WEST INDIA AND WESTERN PAKISTAN

IN three recent issues[1-3] of this journal, Ramaswamy and Bose drew attention to the close association of upper level thermal troughs and lows in the development of Nor'westers in the pre-monsoon season, over North-East India and Eastern Pakistan. An attempt was made by the author to see if a similar association existed between such thermal systems and duststorm and thunderstorm activity over North-West India and Western Pakistan. For this purpose, a preliminary study has been made, in the manner of Ramaswamy and Bose, of partial thermal patterns at 500 mb. (700 ~ 500 mb.) and the associated weather, for all the days in the months of May 1947 and 1954. Though the period examined is small, the results are interesting and suggestive.

The following important points have been observed: (1) Westerly upper level thermal troughs of varying intensity occasionally moved across Western Pakistan and North-West India, in an easterly direction. Sometimes two troughs were seen simultaneously affecting the area, one following the other. These thermal troughs appeared to move on the thermal charts more or less like westerly low pressure troughs on the stream line charts. (2) Some of the thermal troughs were marked and extended upto 300 mb. or more, the axis of the trough at a higher level being westwards of its position at a lower level. Such troughs were associated with large-scale development of duststorms and thunderstorms, if adequate incursion of moisture took place in the lower levels.[3] For example, widespread duststorms and thunderstorms accompanied with ground squalls broke out over North-West India on 11-5-1954, in association with a deep upper level thermal trough while in the absence of such a system, mainly fair weather prevailed on 2-5-1954 (except for a few thunderstorms over the Punjab-Kumaon Hills where a feeble thermal trough existed), though the lower level synoptic situation was similar in the two cases. (3) As the thermal system moved eastwards, the area of thunderstorm activity moved with them, there being, generally, a predominance of thunderstorm activity in the eastern half of the trough.[3-5] It was interesting to note that the spatial distribution of thunderstorm activity had a much closer association with the upper level thermal pattern than with the lower level stream line pattern. (4) The duststorm and thunderstorm activity was particularly marked in the afternoon, when insolation activated to the maximum, the upward impulses provided by the thermal trough.[3]

Ramaswamy and Bose have particularly emphasized the importance of the advection of cold air (in the layer 700 ~ 500 mb.) associated with the upper level thermal troughs and lows, and considered it a factor of great importance in the development of thunderstorm activity over North-East India and Eastern Pakistan. The author[6] has made a study of the radiosonde temperature data of 8 years (1945-52) for an individual station in North-West India, *viz.*, Delhi, and found that only on a small number of occasions, significant advection of cold air took place in the layer 700 ~ 500 mb., prior to the development of duststorms and squall type thunderstorms. During the period March-June when most of the duststorms and thunderstorms occur at Delhi, a fall of more than 3° C. took place on less than 30% of the occasions and a significant fall of more than 5° C. on less than 15% of the occasions. As Delhi can

be taken to be representative of North-West India, it would appear that most of the thermal troughs or lows which cause duststorms or thunderstorms over North-West India and Western Pakistan, have no exceptional coolness in the upper air and as such the dynamical rather than the thermal processes are of greater importance in the development of duststorms and thunderstorms over these areas.

A paper on the subject with full meteorological details is being sent for publication in the *Indian Journal of Meteorology and Geophysics*.

Meteorological Office, Y. P. R. BHALOTRA.
Safdarjung Airport,
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DECAY OF THALLIUM ^{204}

RECENTLY Yuasa *et al.*[1] have reported an analysis of the beta-spectrum of Tl^{204} using a magnetic lens beta-ray spectrometer and applying corrections due to a (*a*) resolution of the spectrometer, (*b*) the screen effect, (*c*) absorption in the counter window, and (*d*) the type of beta-transition involving $\Delta j = 2$, yes. Even after applying these corrections the Fermi-plot was found to deviate from a straight line below about 200 Kev. This deviation has been explained to be due to a second beta-ray group having maximum energy at 400 Kev. From this Fermi-analysis they have estimated the intensity of this beta-ray group to be of the order of 5% of the total beta-ray intensity. This beta-ray group as naturally one expects, fits well as a transition between the ground state of Tl^{204} and the first excited state of Pb^{204}.

Tl^{204} contains 81 protons, *i.e.*, one proton less than required for completion of the 82 proton magic shell and 123 neutrons, *i.e.*, three neutrons less in 126 neutron shell (magic number). From the shell model of the nucleus one expects the spin of Tl^{204} to be $\leqslant 2$ and odd parity. Since Pb^{204} is an even-even nucleus, its spin is assumed to be zero and of even parity. The maximum energy of beta-ray transition from the ground state of Tl^{204} to Pb^{204} is reported to be 765 ± 10 Kev.[1,3] Bi^{204} (17 h. half life) decays[4] to 374 Kev. isomeric state, the first excited state of Pb^{204}, by electron capture; and then to the ground state by emitting a γ-ray of energy 374 Kev. From life-time and internal conversion coefficient measurements of this gamma ray, the spin of this state is determined to be 2 and of even parity, in good agreement with prediction of spin and parity of first excited level of even-even nuclei.[5] This means that a beta-ray transition from the ground state of Tl^{204} to 374 Kev. excited state of Pb^{204} is, energetically and from spin-parity change considerations, possible. ($E_{\beta_2} = 400$ Kev., $\Delta j = 0$, yes.). But no γ-ray of about 375 Kev. energy has been observed in the decay of Tl^{204}. This makes the complexity of the beta spectrum uncertain. Yuasa *et al.* have looked for this gamma-ray in the internal conversion electron spectrum and have reported that there is an indication of a line in the region 215 to 315 Kev. No line, however, corresponding to this energy was found in their scintillation spectrometer. Smith[2] from his scintillation spectrometer study of Tl^{204} has put an upper limit of 10^{-4} per beta disintegration, for this gamma-ray transition.

Decay of Tl^{204} will be more interesting if additional information is collected on the complex nature of the beta-spectrum. With this view, a direct investigation for this gamma-ray and an estimation of its intensity has been made with the the Seigbahn-Slatis Beta-ray spectrometer by recording photo-electron spectrum.

Active Tl^{204} of 610 μc. strength was spread over an area of 6 mm. diameter and was covered with aluminium sufficient in thickness to absorb all primary beta-particles. Over this a lead foil of 40 mg./cm.^{2} thickness and ¾" diameter was placed. A very weak line was observed in the region 280 to 320 Kev. Counting rate near peak position was about 15 c.p.m. more than the background which was 16 c.p.m. Energy of the gamma-ray corresponding to this peak is 380 ± 15 Kev. Since there is no other known gamma-ray line in this decay for comparison of intensity, an indirect method of comparison was adopted.

For comparison, the photo electron spectrum of ·411 Mev. gamma-ray of Au^{198} was taken under exactly similar geometrical conditions as that of Tl^{204} to keep instrumental constant the same for both. The intensities of these sources were determined with the help of a calibrated source Bi^{210} of strength $1{\cdot}81 \times 10^{-2}$ μc. and it was also verified by a direct counting method

in a standard geometrical arrangement. This geometry was in turn standardized by the calibrated sources Bi^{210}, Ux_2^{234} and C^{14}. From (*a*) known strength of Au^{198} ($9{\cdot}1 \times 10^{-2}$ μc.), (*b*) areas under the two photo-electron peaks observed and known decay scheme[4] of Au^{198}, the intensity of 375 Kev. gamma-ray in Tl^{204} was calculated and it is found to be $(8 \pm 2) \times 10^{-5}$ per beta disintegration. This is in agreement with an upper limit put by Smith as 10^{-4} per beta disintegration. Au^{198} source was chosen because its 0·411 Mev. gamma-ray is well established, its intensity is nearly 100%, the gamma-ray energy is very near to the energy of the gamma-ray under investigation, and the atomic number of gold is very near to that of Thallium. Strength of Au^{198} was such that the counting rate was of the same order as that for Tl^{204} source. Au^{198} was prepared by Au^{197} (n, γ) Au^{198} reaction in the cascade generator at this Institute.

My thanks are due to Dr. H. J. Bhabha, for his kind interest and to Dr. B. V. Thosar for helpful comments and suggestions during this work. I wish to thank Dr. R. Ramanna and the Cascade Generator Group, for their help with the irradiation of gold and Mr. S. D. Bhagwat for technical assistance.

Tata Institute of Fundamental Research, Bombay-1, *May* 6, 1955. M. C. JOSHI.

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PHOTOELASTIC CONSTANTS OF THALLIUM ALUM

IT has been reported earlier[1] from this laboratory that the photoelastic behaviour of thallium alum [$Tl\,Al(SO_4)_2.12\,H_2O$] is exceptional in having a positive value of q_{44}, whereas all the other crystals belonging to the T_h class have a negative q_{44}. The individual photoelastic constants of this substance could not be determined, as the elastic constants were not known at that time. The elastic constants are now available[2] and its complete study is undertaken.

The localised fringe method[3] has been adopted to determine the individual photoelastic constants. The prism used is of dimensions 0·385 cm., parallel to [001], 0·298 cm., parallel to [110] and 0·297 cm., parallel to [$\bar{1}$10]. The stress is applied along [001] and a set of localised fringes is obtained making the observation along [110], the source of light being a sodium lamp. The loads for a shift of two complete fringes for vertically and horizontally vibrating beams of light are found to be 1320 and 1050 g. respectively, the mechanical advantage of load being 3·992. The refractive index is taken as 1·498.[4] The elastic constants[2] used are $s_{11} = 49{\cdot}0$, $s_{12} = -15{\cdot}5$, and $s_{44} = 114{\cdot}8$, $\times 10^{-13}$ cm.^{2}.dyne^{-1}. Employing these data, we get

$q_{11} = +6{\cdot}4$ and $\frac{1}{2}(q_{12}+q_{13}) = +11{\cdot}6$, $\times 10^{-13}$ cm.^{2} dyne^{-1}

Combining these with the compensator observations reported earlier,[1] *viz.*, $q_{11} - q_{12} = -5{\cdot}72$, $q_{11} - q_{13} = -4{\cdot}65$, and $q_{44} = +0{\cdot}81$, we get $q_{11} = +6{\cdot}4$, $q_{12} = +12{\cdot}1$, and $q_{13} = +11{\cdot}1$, $\times 10^{-13}$ cm.^{2}.dyne^{-1}. It can be seen that these values are of the same order of magnitude as for other alums.[5]

The axial tilts on the application of stress for various orientations are determined using a polarising microscope. The crystal prism, compressed by means of a small stressing frame, is kept on the stage of the microscope and the angle between the extinction positions and the edge of the prism parallel to the direction of stress is read on the circular scale. This method is found to be more convenient than the one used earlier.[6] There is good agreement between the observed and the calculated values. The angle of tilt obtained, when the stress is applied along [$\bar{2}$11] making the observation along [01$\bar{1}$], is worth mentioning, as it is as large as 33°, whereas the value for other alums is about 5°. This is so on account of the positive sign of q_{44} for this crystal.

The authors wish to express their grateful thanks to Professor S. Bhagavantam for his keen interest in this investigation.

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ESTIMATION AND COMPLEXES OF ZIRCONIUM WITH OXALATES

A METHOD of estimation[1] of zirconium consists in precipitation as oxalate, and ignition to ZrO_2. The present communication shows that the precipitation can be followed quantitatively by potentiometric measurements.

A. R. grade $Zr(NO_3)_4$ was dissolved to form a 0·1 M solution. A given volume of the solution was taken in a Pyrex vessel, and the following cell formed:

$Hg \mid Hg_2Cl_2, KCl$ sat. $\parallel KCl$ sat. $\parallel Zr(No_3)_4 \mid Pt$

The e.m.f. (E) of the cell was determined against a 2-volt accumulator after successive additions of small amounts of a standard solution of $Na_2C_2O_4$ from a burette, and thorough mixing. In Fig. 1 are shown a representative

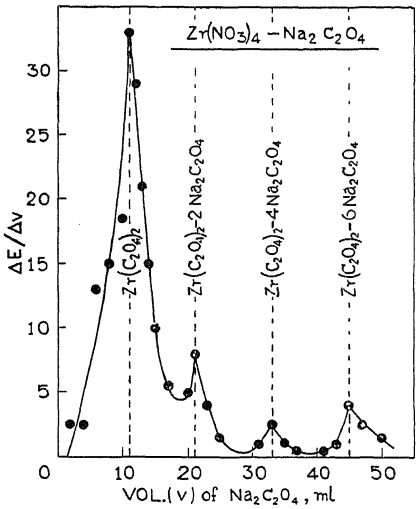


FIG. 1

set of plots of $\Delta E/\Delta v$ against the corresponding volume (v), in ml., of the $Na_2C_2O_4$ solution. Results with other soluble oxalates and oxalic acid, and at various concentrations, were similar.

The curve in Fig. 1 shows four well-defined peaks corresponding respectively to quantitative precipitation of zirconium as $Zr(C_2O_4)_2$ and three oxalate complexes in which zirconium is associated with 4, 6 and 8 oxalate ions. The formation of the first complex is accompanied by complete dissolution of the precipitated $Zr(C_2O_4)_2$.

Grateful thanks of the authors are due to Prof. S. S. Joshi for his kind interest in the work.

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CITRATE RADICAL-ION POLYMERIZATION OF METHYL METHACRYLATE

FOLLOWING the work of Evans and Uri,[1] a detailed investigation of the polymerization of vinyl monomers with the ion-pair complexes of the type $Fe^{3+}X^-$ where X = hydroxyl, chloride and azide has been carried out by Evans, Santhappa and Uri.[2] Some of the results obtained in the polymerization of methyl methacrylate with the ferric citrate complex (Fe^{3+} $HCtr^{2-}$) irradiated at 365 mμ are reported here. The studies have been confined to a pH range of 0·5 to 0·7 in which the concentration of the active ion-pair $FeOH^{++}$ is minimal and therefore ferric citrate complex is the only active sensitizer.

The following scheme contains reactions which are likely to occur:

$$Fe^{3+} + H_3Ctr \text{ (citric acid)} \rightleftharpoons Fe^{3+}HCtr^{2-} + 2H^+ \quad (1)$$

Irradiation and electron transfer,

$$Fe^{3+}HCtr^{2-} \underset{k_d}{\overset{h\nu}{\rightleftharpoons}} Fe^{2+}HCtr^- \quad (2)\ \&\ (3)$$

Production of radicals,

$$Fe^{2+}HCtr^- \underset{k_0}{\overset{k_s}{\rightleftharpoons}} Fe^{2+} + HCtr^- \quad (4)$$

Initiation

$$M \text{ (monomer)} + HCtr^- \xrightarrow{k_i} HCtr^- - M - \quad (5)$$

Propagation,

$$HCtr^- - M - + M \xrightarrow{k_p} HCtr^- - M - M - \quad (6)$$

Termination,

$$2HCtr^- - (M)_n - \xrightarrow{k_t} 2HCtr^-(M)_n \quad (7)$$

or $$HCtr^- - (M)_n - (M)_v - HCtr^-$$

Assuming stationary concentrations for free radicals and free radical chains it is easy to obtain the following expressions for quantum yield with regard to ferrous ion production γ_{net}, the rate of monomer disappearance $-dM/dt$ and the degree of polymerization, P_n. These expressions may be considered for testing how far the scheme given above is applicable to the system under investigation.

$$\gamma_{net} = [k_s \mid (k_s + k_d)]\{k_i[M] \mid (k_0[Fe^{2+}] + k_i[M])\} \quad (8)$$

$$-dM/dt = (k_p \mid k_t^{\frac{1}{2}})[k_s k_\epsilon I \mid (k_d + k_s)][M] \quad (9)$$

$$P_n = (-dM \mid dt) \mid \tfrac{1}{2}(dFe^{2+} \mid dt) \text{ for termination by combination} \quad (10)$$

$$= (-dM/dt) \mid (dFe^{2+} \mid dt) \text{ for termination by disproportionation} \quad (11)$$

Determination of $-dM/dt$ were made by the familiar method of weighing the purified and dried polymers and degrees of polymerization were determined by measuring the viscosities of dilute solutions of polymers in benzene.[3] Quantum yield for ferrous ion production γ_{net} was obtained by measuring the rate of ferrous ion production colorimetrically with 0-0′ phenanthroline. The intensity of light I was determined actinometrically and k_ϵ, the light absorption fraction for the ion-pair Fe^{3+} $HCtr^{2-}$ was determined from a knowledge of the molar extinction coefficient of the ion-pair and the equilibrium constant for its formation.

The equilibrium constant for the formation of ferric citrate complex (step 1 in the scheme above) was evaluated by measuring in a Beckman Spectrophotometer (Model D.U.) the optical density of the system containing the species Fe^{3+}, $FeOH^{++}$, $FeHCtr^{+}$, H_3Ctr, $FeSCN^{++}$ at 525 mμ at which all the species except $FeSCN^{++}$ have negligible absorption. The molar extinction coefficient curve obtained for the species $FeSCN^{++}$ (Fig. 1, A) differed

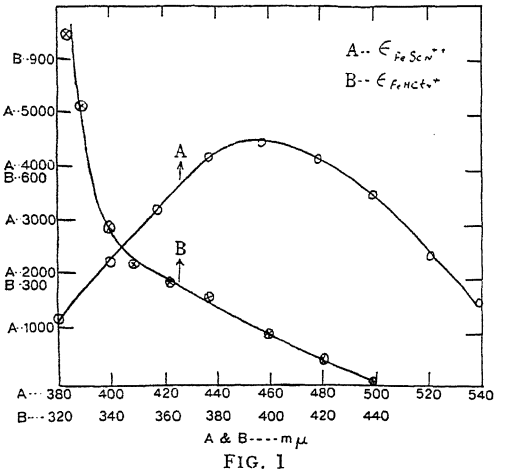


FIG. 1

slightly from that by Frank and Oswalt[4] who also obtained a value $\epsilon = 1875$ at 525 mμ and a mean value of 136·2 for the equilibrium constant for the formation of $FeSCN^{++}$ The values obtained for these by us were 2200 and 137·4 respectively. A mean value of 1·2 was obtained for the equilibrium constant for the formation of ferric citrate complex at ionic strength 1·0. Though this differed largely from that by the earlier workers,[5] yet the value of k_ϵ which is concerned in the work is relatively unaffected.

When the system $FeHCtr^{+}$ methylmethacrylate in aqueous solution is deaerated and irradiated with ultraviolet light of wavelength larger than 300 mμ, polymerization was noticed within almost one minute. Wavelengths as high as 400 mμ were found to be effective although 365 mμ was used in our experiments. The results with different concentrations of methylmethacrylate monomer are given in Table I.

There is a small variation in quantum yield for ferrous ion production (0·13 to 0·15) as the monomer concentration varies from 0·14 to 0·04 molar. The molecular weight averages of unfractionated polymethyl-methacrylate polymers ranged from ca. 200,000 to 600,000. The discrepancy between calculated and measured degrees of polymerization decreases as the monomer concentration is increased. It is concluded that $FeHCtr^{+}$ as an initiator is of

TABLE I

[M] (molar)	$d[Fe^{2+}]/dt$ (moles/hr.) × 10^6	γ_{net}	$-dM/dt$ (moles/hr.) × 10^4	P_n measured	P_n calculated
0·04	3·4	0·1557	3·81	..	..
0·08	3·2	0·1468	11·43	2556	713
0·094	3·9	0·1803	16·0	..	812
0·12	3·07	0·1408	16·5	3530	1519
0·14	3·0	0·1374	16·92	6457	1128

$[Fe^{3+}] = 10^{-3}M$; $[H_3Ctr] = 5 \times 10^{-3}M$; $[HNO_3]$ $= 0·19M$; pH 0·7; μ 0·2
$I = 5·08 \times 10^{-5} Nh\nu$/hr; $k_\epsilon = 0·43$; [M] = Methylmethacrylate

the same type as $FeCl^{++}$ and $FeOH^{++}$ and it appears to be of the same order of reactivity as $FeCl^{++}$ with which the quantum yield for ferrous was 0·13. The small variation of γ_{net} with change in monomer concentration and the difference in measured and calculated P_n are to be traced partly to reactions of the radicals with the other unrecognised species in the system as has been already reported[2] with $FeOH^{++}$ and $FeCl^{++}$ initiators.

A detailed account will be published elsewhere.

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GLACIATION IN THE VINDHYAN SYSTEM*

THE author, accompanied by Mr. G. C. Taylor (of the U.S.G.S. now with the G.S.I.) and Dr. B. P. Tewari (Director of Industries, V.P., formerly of the G.S.I.), discovered a distinct tillite below the Pandava Falls, about 7 miles from Panna, on the Chattarpur Road. It contains large erratics in a fine matrix, and there is no evidence of sorting or bedding. It is, however, overlain by a conglomerate which passes upwards into what are considered to be varvites. Mallet[4] has mapped the area as belonging to the Kaimur Series, and this is apparently correct. There can be no doubt that the tillite belongs to the Vindhyan System.

The Shahidan Mines were also examined and it was felt that the thinly-bedded shales could be varvites. The intricate local folding was, perhaps, induced by moving ice during an extension of glaciation. This concept envisages a tillite younger than the shales, and it is, perhaps, significant that Sinor[6] described an overlying conglomerate which could be of glacial origin.

These discoveries open two possibilities, firstly, that the Gangau tillite, originally reported by Dubey and Chowdhury[3] as of basal Vindhyan, but later described separately by Chowdhury[2] and Mathur[5] as Bijawar, may yet be of Vindhyan age. The presence in it of jasper pebbles, and the occurrence of passage beds above them, as reported by Ahmad and Narain[1] recently, is hardly reconcilable with Bijawar age. And secondly that the Hindoun, Karauli and other breccias reported from the Vindhyan System by earlier workers may all have a glacial origin. The confusion about their origin is, thus, likely to be resolved.

This envisages persistent and repeated glaciation in the Cambrian of Central India.

Geol. Survey of India, Calcutta-13, *November* 15, 1954. F. AHMAD.

* Published with the kind permission of the Director, Geol. Survey of India.

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EFFECT OF DEFICIENCY OF RIBOFLAVIN AND NICOTINIC ACID ON THE SYNTHESIS OF ACETYL CHOLINE IN RATS

IN our previous investigation[1] on the biosynthesis of acetyl choline in rat tissues, it was reported that individual deficiency of thiamine and pantothenic acid in the diet produces a great decrease in the acetyl choline content of liver, brain and heart tissues, thus supporting the concept that both these vitamins are involved in the synthesis of acetyl choline-thiamine as co-carboxylase and pantothenic acid as coenzyme A in forming acetyl group necessary for acetylation of choline by phosphoroclastic split of pyruvic acid into acetyl-phosphate through the intermediate of acetyl COA complex.[2,5,7]

In view of nicotinic acid and riboflavin constituting and functioning as cofactors of various dehydrogenase systems in the body,[3,4] it was thought that deficiency of these two vitamins may influence the acetylcholine synthesis in rat tissues. The investigations were conducted on four groups of ten young male rats of 40-50 g. body-weight each kept on a synthetic diet of the following composition: starch—52%, casein—20%, sugar—15%, salt mixture (McCollum and Davis)—4%, ghee—6%, cod liver oil—2%, vitamin mixture—1%. The composition of the vitamin mixture was the same as reported in our previous investigation.[1] Group I was kept on synthetic diet with all the vitamin supplements but in Groups II, III and IV, nicotinic acid, riboflavin and thiamine were omitted respectively from the vitamin mixture. The rats were fed *ad libidum* for a period of 6-8 weeks till the deficiency symptoms were produced. They were then sacrificed and the heart, brain and liver were removed and the tissues minced and ground in eserinised tyrode solution and centrifuged. The supernatant tissue extracts were assayed for acetyl choline content according to the method previously described.[1] The response of a small and a high dose of each extract was tested and the average acetyl choline content of the tissues were then calculated by comparison against the standard. The result are presented in Table I.

From the results it is evident that deficiency of nicotinic acid and riboflavin effects a significant and almost similar decrease in acetyl-choline content of heart, brain and liver tissues. Thiamine deficiency produces much greater decrease than the deficiencies of nico-

TABLE I

Showing the average acetyl choline content per gram of tissues and percentage reduction in deficient groups of rats

Tissues	Control Group I	Nicotinic acid-deficient Group II		Riboflavin-deficient Group III		Thiamine-deficient Group IV	
	Acetyl choline µg./g.	Acetyl choline µg./g.	Reduction as compared to control	Acetyl choline µg./g.	Reduction as compared to control	Acetyl choline µg./g.	Reduction as compare to contr
Heart ..	4·73	2·88	41·6%	2·6	45·06%	1·208	74·46%
Brain ..	2·46	1·61	34·5%	1·75	29·86%	0·50	79·6%
Liver ..	2·376	0·24	89·5%	0·32	86·5%	0·125	94·7%

tinic acid and riboflavin. This suggests that thiamine is primarily involved in the biosynthesis of acetyl choline, because of its main function in the production of acetyl groups from pyruvic acid by participating as diphosphothiamine in the first of the chain of reactions, *i.e.*, decarboxylation of pyruvic acid to acetaldehyde COA complex in presence of COA as postulated by Korkes *et al.*[3] and Ochoa and Stern.[6] Further, the higher percentage of decrease of acetyl choline in case of liver tissue in all the deficient groups suggest that this tissue may primarily be responsible for the large part of biosynthesis of acetyl choline in body.

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March 29, 1955.

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S. S. GUPTA.
H. N. DE.

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THE BASIS OF STARLING'S LAW OF THE HEART

STARLING found that the force of contraction of the heart increases with the length of the fibres composing its walls. The question arises whether this property of the heart is due to changes in the membrane, that is, the excit tory system, or the contractile mechanism.

In unstriated muscle, the excitatory syste can be destroyed by heating for 10 minutes 50° C. (Singh and Singh[1-3]). This preparatic is relaxed actively by heat and some chem cals that cause denaturation of proteins. denaturation is presumed to be accompanied l unfolding of the polypeptide chains, this shov that relaxation of muscle is due to unfoldir of the polypeptide chains, and provides indire evidence of chain-folding during contractio The heat-killed muscle is made to contract l some protein coagulants, and the responses thi produced resemble the responses of the livi muscle very closely, thus indicating that tl normal contractile process in muscle resembl the coagulation of proteins (Singh a Singh[4,5]).

The heat-killed muscle is made to contract l hydrochloric acid solution and by heating to 70° Striated and unstriated muscles give powerf contractions, and the latter shows more forcib contraction with increase in length up to certain extent. In heart muscle it is difficult obtain a piece with parallel fibres, so the cor traction is not so powerful. To show Starling law on the heat-killed heart muscle, transver pieces of the right ventricle of the dog's hea are used; the whole of the frog's heart can l suspended like an ordinary piece of unstriate muscle. In heart muscle, the heat contracti is partially reversible, so that a tonic contra tion persists after the first heating to 70° C but on this tonic contraction, reversible cor tractions can be superimposed. These contra tions can be used to study the properties of tl contractile mechanism of the heart muscle.

The heat-killed heart muscle shows Starling law of the heart (Fig. 1). These experimen

show that the basis of the law is some change in the proteins of the muscle, which respond by more forcible contraction, if they are stretched.

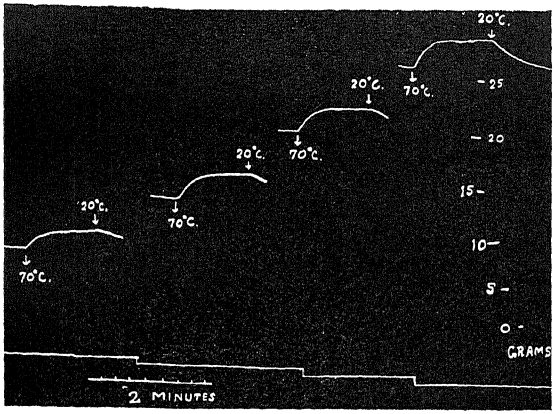


FIG. 1. Frog's heart killed by heating to 50° C. (*Rana tigrina*). Effect of stretching on the tension produced by heating to 70° C. Note that the last contraction is about double the first. The length was increased by 3-4 per cent. each time.

Dept. of Physiology, SUNITA INDERJIT SINGH.
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Agra, *April* 11, 1955.

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DISTRIBUTION OF RADIOACTIVITY IN THE KHONDALITES OF ANDHRA STATE

KHONDALITE series are extensively developed in the Eastern Ghats. A typical khondalite essentially consists of quartz, felspar, garnet, sillimanite and graphite with magnetite, apatite and rutile as accessories. Khondalites are intruded by charnockites and pegmatites resulting in the development of a complex group of interaction rocks. Beta-activity was determined, according to a method earlier outlined,[1] for 36 specimens of khondalites drawn from Krishna, Godavari, Visakhapatnam and Srikakulam Districts (16° 30′ E to 19° 30′ E and 80° 36′ to 83° 42′) of Andhra State.

The radioactivity data on khondalites are studied from three mutually-related aspects—(*i*) mineralogical constitution and radioactivity, (*ii*) associational characteristics and radioactivity, and (*iii*) radioactivity and petrogenesis.

(*i*) It is found that an increase in the radioactive content can be correlated to an increase in the total content of garnet and sillimanite and a decrease in the content of quartz. It appears that the high radioactivity in khondalites is associated with heavy minerals—mostly garnets and sillimanite, which is supported by the correlation between the radioactive content of and the percentage of heavy minerals in the khondalites (Table I).

TABLE I

Heavy mineral content and radioactivity

Specimen No.	Percentage of heavy minerals in the rock	Radioactive content (in ppm. of U)
2	73·38	12·86
7	60·72	8·72
21	43·57	4·09

As can be expected,[1] specimens of khondalites which bear evidences of later felspathisation are characterised by a higher radioactivity than the non-felspathised ones.

(*ii*) The mode of association of khondalites seems to have a profound influence on the distribution of radioactivity in the rocks. While the association of khondalites with pegmatites, charnockites and interaction rocks seems to enhance the radioactivity of the former, occurrence in the proximity of calc-granulites, quartzites and quartz-veins appears to depress it (Table II).

TABLE II

Associational characteristics and radioactivity of khondalites

Nature of association	Number of specimens examined	Mean radioactive content (in ppm. of U)
Pegmatites	2	16·96
Charnockites	4	10·50
Interaction rocks	8	10·41
Calc-granulites	2	7·94
Quartzites and quartz veins	6	7·11

(*iii*) The high radioactivity of khondalites (9·32 ppm. of U) is visualised as a

manifestation of either or both of the two processes: hypo-metamorphism, and adsorption of radioactive matter in the colloidal phase. Khondalites were subjected to hypo-metamorphism[2] and it is possible that the extreme conditions of temperature and pressure under which such a process took place, might have facilitated the dissemination of radioactive matter into the khondalites.[3] Alternately, it can be surmised that the colloidal clayey and organic components of khondalites were instrumental in chemically adsorbing uranium from ocean waters at the time of deposition.[4-6] Of the two possibilities, the second one is more probable, but it cannot be ruled out that both might have participated to bring about the present distribution of radioactivity in khondalites.

It is suggested that radiometric work in areas where khondalites are rich in argillaceous and carbonaceous components may bring to light significant sources of uranium.

The investigations were sponsored by the Council of Scientific and Industrial Research.

Geology Dept., Andhra University, Waltair, *April* 14, 1955.

C. MAHADEVAN.
A. V. R. SASTRY.
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EFFECT OF IONIC SIZE, CHARGE AND VALENCY ON DONNAN DIFFUSION IN CATION-EXCHANGE MEMBRANE

IN a previous publication[1] the variation in chloride uptake by two samples of cation-exchange membranes in hydrochloric acid, sodium chloride and barium chloride solutions was reported. This note describes the results obtained with Nepton CR-51 cation-exchange membrane in different salt solutions.

The membrane was converted to the different salt forms for determining the amount of chloride absorbed by the Donnan diffusion process. The determinations were carried out in a manner similar to that reported earlier.[2]

In Fig. 1, the ratio of the amount of chloride absorbed by the membrane (N_A) to the external chloride concentration N_A/N_{Ext} is plotted

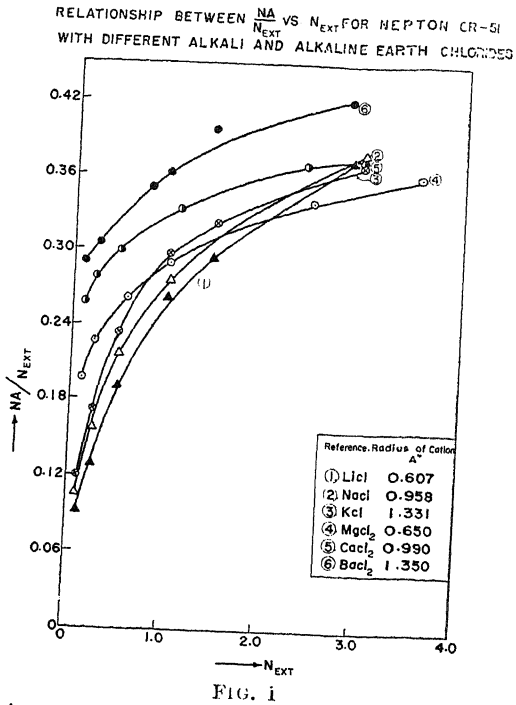


FIG. 1

against the external chloride concentration (N_{Ext}). The results reveal that among the divalent alkaline earth salts the uptake of chloride is highest with barium chloride (cation radius 1·35 Å) and lowest with magnesium chloride (cation radius 0·65 Å). Similarly, among the alkali salts reported in this note, the uptake of chloride is found to be highest with potassium chloride (cation radius 1·33 Å) and lowest with lithium chloride (cation radius 0·607 Å). The effect of charge and valency of the cation on the chloride uptake by the cation exchange membrane is revealed by the difference in the amount of anion absorbed when using barium chloride (divalent and of ionic radius 1·35 Å) and potassium chloride (monovalent and of ionic radius 1·33 Å) solutions. Thus, the quantity of anion diffusing into the cation-exchange membrane is seen to depend on the ionic radius of the cation, and among cations of almost similar ionic radii their charge and valency govern the quantity of anion diffusing into the membrane.

Full details of the work will be published elsewhere.

National Chemical Laboratory of India, Poona-8, *April* 1, 1954.

N. KRISHNASWAMY.

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PAPER CHROMATOGRAPHY AND RADIOAUTOGRAPHY OF AMYLASE

HOKIN AND HOKIN[1] have shown that a correlation exists between uptake of radioactive phosphorus (P^{32}) into the phospholipids and amylase synthesis in pigeon pancreas slices. Factors which stimulated or inhibited amylase synthesis also had a similar effect on uptake of P^{32} by phospholipids. Fischer and Bernfeld[2] have found that inositol phospholipid accompanies amylase during the purification of the enzyme. Recently we have provided evidence which indicates that inositol is involved in the activity of amylase[3] in confirmation of earlier evidence to that effect.[4] In order to provide additional evidence for this function of inositol and in the light of the above observations, it was thought of interest to determine if the amylase synthesised by pigeon pancreas slices *in vitro* is secreted into the incubation medium as the enzyme-phospholipid complex or lipoprotein. Bernfeld *et al.*[5] have concluded from molecular weight determinations of crystalline pancreatic amylases of different animal species that the enzyme protein is free of phosphorus. It was, therefore, thought that if the amylase is secreted into the medium as enzyme-phospholipid complex the enzyme thus secreted would be radioactive. In order to test this possibility paper chromatography and radioautography of the amylase synthesised and secreted into the incubation medium by pigeon pancreas slices in presence of radioactive phosphate has been carried out.

Pigeon pancreas slices were incubated for 2 hrs. at 37° C. in sheep serum (inactivated by heating at 60° C. for 2 hrs.) in Warburg flasks in an atmosphere of 95% oxygen 5% carbon dioxide. Fifty μc. of radioactive phosphate (P^{32}) were added to each flask at the start of the incubation period. At the end of 2 hrs., the slices were removed from the flasks and ground up with sand and water. Aliquots of the enzyme extract and of the incubation medium were passed through Amberlite IRA-400 to remove the added inorganic phosphate and were then spotted on a line near one end of a filter-paper sheet. The technique of ascending chromatography was employed and the development was carried out at 0°-5° C. in view of the instability of the enzyme at higher temperatures. As developing solvents (i) 50% acetone,[6] and (ii) 10% ammonium sulphate[7] were employed and these gave good separation between the enzyme and the added inorganic phosphate. For the detection of the amylase spots the technique of Giri *et al.*[6] was employed. The Rf values of the amylase in the above two solvents were respectively 0·42 and 0·31. For detection of radioactive spots, radioautography was employed. For this the developed chromatogram was placed in contact with an ILFEX X-ray film for 72 hrs. and the film was subsequently developed. The radioactive spots showed up as dark spots on the negative film and coincided with the positions of the amylase and inorganic phosphate on the chromatogram. The results obtained thus showed the presence of radioactive phosphorus in the amylase synthesised and secreted into the medium. As the radioactive phosphorus in the amylase is not removed on passing through the Amberlite resin, it is not inorganic in nature. Also, spraying the developed chromatogram with the phosphate reagent of Fiske and Subbarow[8] indicated the absence of inorganic phosphate in the position of the amylase spots. This finding, in conjunction with that of Bernfeld *et al.*,[5] indicates that the radioactive phosphorus is probably present as the phospholipid and the amylase itself is synthesised and secreted as the enzyme-phospholipid complex.

The authors wish to express their gratitude to the Indian Council of Medical Research for financial assistance.

University Biochem. Laboratory, Madras-25, *April* 21, 1955.

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TAMARIND SEED POLYSACCHARIDES

IN earlier communications Savur and Sreenivasan[1-3] have conclusively shown that tamarind seed polyose differs fundamentally from fruit pectins in its behaviour and chemical make-up. Hitherto tamarind seed meal had been known to contain only one type of polyose. How-

ever, the present investigation reveals that tamarind kernel powder contains three distinct types of fractions, which differ in their solubility and power of gelatinization and therefore they have been designated as fractions P_1, P_2 and P_3. Fraction P_1 is soluble in water within 2-3 minutes at 5° C. and the yield varies from 2-4%; fraction P_2 is soluble at room temperature when the seed meal is vigorously stirred with ten times its weight of water for about 45 minutes, the yield being 20-30%; while, fraction P_3 is insoluble in cold water, but is completely soluble on boiling for 20 minutes, and the yield varies from 30-35%. Fraction P_1 has no jellying property, while polyoses P_2 and P_3 have excellent jellying and sizing properties. The polysaccharides can be separated by: (1) Dialysis; (2) Partial hydrolysis with dilute acids; (3) Fractional precipitation with alcohol from warm water solutions; (4) Fractional precipitation with ammonium sulphate; and (5) Separation by electrostatic precipitation has only been partially successful. Therefore the assumption of Rao and White[4] that the tamarind kernel powder contains only one single polysaccharide is rather doubtful.

During recent years tamarind kernel powder has attained considerable commercial importance primarily as a sizing material due to its approximately 46-48% polyose content, but its application in industry has been limited in view of the fact that tamarind seed meal is invariably associated with about 52-54% of non-polyose materials such as testa particles, proteins, oils and fats, crude fibres, mineral matter, hemicelluloses, oligosaccharides, etc. Tamarind seed polysaccharides, mixture of P_2 and P_3 find extensive application in textile industry for sizing purposes, finishing and printing of cotton and artificial silk[5] and it also finds great scope in food industries.[6] It can be used as a substitute of cereal gums in rubber industry, plastic industry, paper industry, cardboard manufacture, triply wood industry, pharmaceutical and fine chemical industry, cosmetics and various other industries. A plant for manufacturing tamarind seed polyose has gone into operation in Bombay by a process patented by the author.[7] The process involves the bringing of the non-polyose materials and fraction P_1 from tamarind kernel powder into a homogenous aqueous solution at room temperature without causing gelatinization and without the application of heat, while the polyoses P_2 and P_3 are maintained in an insoluble state, whereupon the two components are separated by dilution and by dialysis.

The Pectin Manfg. Co. Labs., Bombay-40, *March* 7, 1955. G. R. SAVUR.

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EXPERIMENTAL INFECTION OF INDIAN MAJOR CARPS WITH *ICHTHYOPHTHIRIUS MULTIFILIS* FOUQUET*

IN the middle of March 1955 a local aquarist Shri G. Malik reported a heavy mortality of young *Xiphophorus hellerii* in his aquaria. The infected fishes were having white spots on their body which on examination were found to be due to a protozoan *Ichthyophthirius multifilis* Fouquet. The aquarist was advised to change the water in the aquaria and give repeated baths to the fishes in 3% salt solution and also put as much salt in the aquarium as the fishes could tolerate. After 3 days the mortality was reduced considerably.

The infected fishes were put in a glass trough containing 14 litres of water along with two specimens each of *Labeo bata* (8 cm.) and *Cirrhina mrigala* (8 cm. and 8·5 cm. long). The carps were found infected after 3 days. Details are given below:

21-3-1955	Infected fishes introduced with carps.
24-3-1955	White spots appeared on the body of carps.
26-3-1955	White spots increased in size, parasite came out of a cyst on the body.
28-3-1955	White spots disappeared from the body of fish.

The temperature of the water varied between 28-30° C. and pH 7·6-8·4.

The above experiment shows that the Indian major carps are susceptible to infection by *Ichthyophthirius*, and under favourable conditions there is every chance of the parasite becoming a pest in the nursery ponds where the fishes are crowded and the water is stagnant; the two prime factors favouring its infection.

This parasite has proved very harmful in the hatcheries and aquaria in Europe, America, Australia, Tasmania and Japan. It is understood that in the fish ponds in Central China this parasite is found to infect the Chinese carps and it is controlled there by the application of 0·5 parts per million of copper sulphate to the pond water.

The life-history, infection and control of this parasite have been studied by Plehn,[1] Davis,[2] Butcher,[3] Barthélémy[4] and Prytherch.[5] The period of quarantine according to these authors varies from a week to a fortnight depending on the temperature of the water. In India, quarantine for one week will suffice to show the infection.

It may be pointed out here that the water from the infected aquaria should be sterilised either with formalin or creosote oil before being thrown out, and the dead infected fishes similarly treated. This disease seems to be new to India as there is no previous record of its infection. Every care should be taken not to introduce new diseases and parasites along with the imported fishes which may become an established menace to our fish farmers.

Central Inland Fisheries Research Station, Calcutta-7, *May* 5, 1955. Y. R. TRIPATHI.

* Published with the permission of the Chief Research Officer.

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INHERITANCE OF A NEW TYPE LEAF IN RAPE

THE leaves of the Yellow *Sarson* plants are of the typical lyrate form as shown in Fig. 1 (extreme left). The lyrate form is characterised by the presence of a broad terminal lobe with an obovate apex. The incisions in the normal type of leaves of Yellow *Sarson* almost touch the midrib and the lobes are somewhat perpendicular to the midrib. In the lower half of the leaf the lamina is represented only by a very narrow streak along the midrib and the lobes are separated from each other with an indistinct sort of lamina in between the lobes. During 1952-53, a plant bearing a new type of leaves was found. The leaves borne by this plant were quite different from other varieties of Yellow *Sarson* collected so far from any part of India or abroad. The new type leaf (Fig. 1, extreme right) does not possess a broad terminal lobe like the normal type, but has a small terminal lobe with an acute apex. The incisions in the lamina do not touch the midrib and the lobes are not separated from each other. There is a distinct lamina along with the midrib. The lobes in the upper part of the leaf instead of being perpendicular like the normal type form an angle with the midrib. Its leaf character bred true in the succeeding generations.

In order to study the inheritance of the new type leaf, crosses were made in 1952-53 between the new type leaf individual and the variety, Pb. *Sarson*, bearing normal type leaves. The F_1 shown in the figure (Fig. 1,

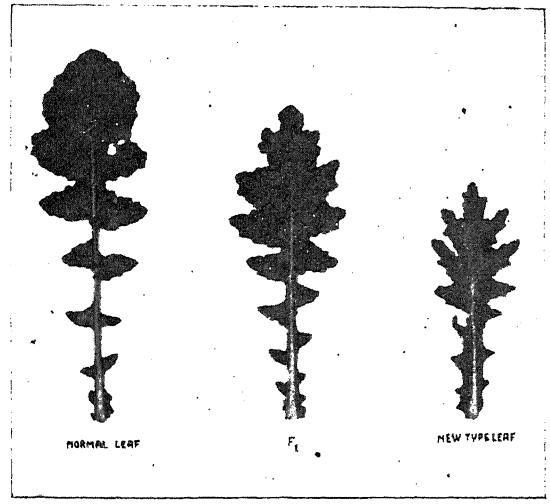


FIG. 1

centre), while closely resembling the new type leaf yet differs from it in certain characters. The incisions in the lamina in the lower part of the leaf are deeper and almost touch the midrib and at some places only a streak of lamina is left. However, the lobes are not widely separated from each other like the normal type leaf. The lobes in the F_1 type leaf do not form an acute angle with the midrib like the new type leaf. Thus the characters of the new type leaf may be considered as partially dominant over the normal type leaf. In F_2 the following results were obtained: New Type—137 plants; F_1 type—314 plants;

Normal Type—162 plants. χ^2 value is 2·378 and P value is 0·10 to 2·0.

The F_2 data give a good fit to a 1 : 2 : 1 ratio, the χ^2 value showing that the deviation is not significant. From this it may be concluded that the differences in the characters of the two types of leaves are controlled by one major gene and the characters of the new type leaf are partially dominant over the normal type. It is suggested that the new type leaf may be designated by the factor 'N' and the normal type by '*n*'.

Govt. Res. Farm, DHARAMPAL SINGH.
Kanpur, Uttar Pradesh,
January 13, 1955.

COLCHICINE INDUCED SECTORIAL CHIMÆRA IN *CYCLOSORUS REPANDULUS* (v.A.v.R.) CHING

Cyclosorus repandulus (v.A.v.R.) Ching is a diploid species with $2n = 72$ (Manton and Sledge[1]). Due to difficulties experienced in obtaining interspecific hybrids between this diploid species which came from Ceylon and some related tetraploids from Ceylon and Malaya, attempts were made to produce an autotetraploid of the diploid species after treatment with colchicine. It was intended to attempt crossing between the artificial autotetraploid (despite its expected low fertility) and the wild tetraploids, since the chromosomal incompatibility between the diploid and the tetraploids may thus be expected to break down.

Two sets of 6 sporelings at the three-leaved stage were each immersed in a 0·3% and 0·15% aqueous solution of colchicine respectively for 24 hours, whereas to the apical meristems of the third group of 6 sporelings 0·2% colchicine solution was added in drops. Then the treated sporelings were washed and potted in earthernware pots containing soil mixture made up of peat, sand and loam in the proportions of 3 : 2 : 1.

Root tips of individual plants were analysed by squash techniques, being slight modifications of the techniques used by Tjio and Levan[2] to suit plant materials of this fern species. Root tips were treated with half-strength aqueous solution of 8-hydroxyquinoline[2] in small specimen tubes, which were corked and kept immersed in running tap water (between 16-18° C. in Leeds) for 4-6 hours. This pre-treatment contracted the chromosomes appreciably for better spread.

The chromosome counts of these treated root tips were made in one of two ways: (*i*) This was the same as outlined by Tjio and Leva with the only modification that a saturat solution of orcein in 45% acetic acid was us instead of 2% orcein as recommende (*ii*) When the number of separate root tips w too many to be analysed at a time, these we fixed in Carnoy's solution (4 : 3 : 1 instead 6 : 3 : 1) after decanting the hydroxyquinoli solution, and left in the refrigerator at 4° to be squashed at leisure in the same way in (*i*).

The above cytological analysis showed th only one of the sporelings treated with 0·3 colchicine solution produced roots, some which possessed 72 somatic chromosom (Fig. 1), whereas the others had 144 (Fig. 2



FIG. 1



FIG. 2

Evidently, this plant has a sectorial chimæ derived by the doubling of the diploid chrom some complements of a sector of the ro meristem by the action of colchicine, whic however, could not influence mitosis in th other sector, presumably due to its incomple action on a large meristematic tissue of sporeling at the three-leaved stage. Co sequently, the two sectors produced tetraploi and diploid roots respectively during the ont geny. This is the first recorded case whe colchicine was used to induce autotetraploid in ferns, resulting, however, in the productio of a sectorial chimæra.

Grateful thanks are due to Professor Manton of Leeds for supervision and guidanc

Ravenshaw College, G. PANIGRAHI.
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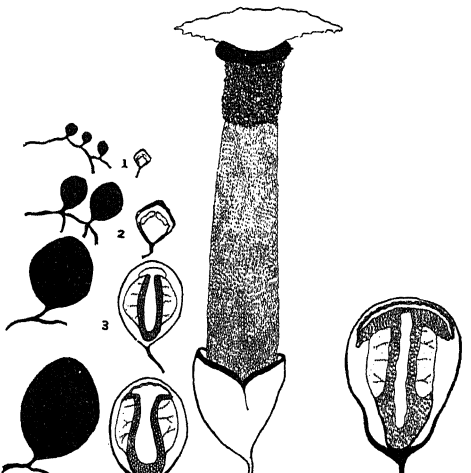
A NOTEWORTHY PHALLOID FROM AHMEDABAD

IN the course of the studies on the higher fung of Ahmedabad and its immediate environs, th author came across an interesting phalloi *Itajahia galericulata* Alfr. (Syn = *Phallu roseus* Delile; *Itajahia rosea* Fischer) occurrin in abundance, on decaying vegetable debri under trees of *Melia azadirachta* L. They mak their appearance in rainy season especially i August and September. Fischer,[1,2] Narasimhan,

Petch[4] and Sultan Ahmed[5] have recorded the occurrence of various members of soil fungi belonging to the group phalloideæ. However, the occurrence of *Itajahia galericulata* has been recorded only in the Punjab plains, where Sultan Ahmed[5] was able to describe only the mature plant. In the present paper a few interesting field observations are recorded.

This phalloid assumes bizarre shapes and appears in abundance during heavy rains. The mature specimens collected varied from 8-21 cm. in height and from 1·8-4·7 cm. in diameter (Fig. 5). The well grown stalk is turgid, and white or pale rose in colour. The stalk is generally circular in outline and sometimes flattened and stunted in growth. It is hollow, with mucilage, broad towards the apex and forms a distinct, thick, circular apical collar spreading over the gleba in an arch-like manner. The margin of the collar is either smooth or lacerated. The collar has a distinct apical cap, which is moderately thickened and has a regular or lacerated margin. The cap remains intact on the collar (if there is no disturbance) for a fairly long time.

Just beneath the collar the receptacle is situated. It is globose with white lamellate plates of sterile tissue traversing the gleba. The gleba surround the distal portion incompletely. It is dark, olive-green in colour, viscid and emits abominable smell.



FIGS. 1 to 4, 6. Various stages in the development of volva and their longitudinal sections, × ¼.

FIG. 5. Mature plant, × ¼.

The mycelium is composed of white, cord-like strand spreading widely on the rotting woody parts. It bears innumerable eggs from the size of a pin's head to that of hen's egg (Figs. 1-4, 6). The eggs terminate short branches and mostly develop in groups and rarely in isolation. The growth of the egg depends upon the moist environment. If there is increased and continuous precipitation, the volva increases in bulk, and shows signs of rupture on the twenty-third day. However, with the onset of dryness, the volva of various sizes begin to rupture. First there is a split exposing partly the apical portion. Within 12-18 hours, the stalk of various sizes emerges out displaying the gleba with a well-developed collar and cap.

M. R. Science Institute, T. ANANDA RAO.
Gujarat College, Ahmedabad,
February 14, 1955.

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A POWDERY MILDEW ON *CARICA PAPAYA* L.

A POWDERY mildew caused by an *Oidium* was recently noticed in Poona, causing severe damage to young seedlings of *Carica papaya* L. in horticultural nurseries.

The disease is mainly encountered in nurseries on young seedlings and is absent from adult plants. The mildew develops as small circular specks on both sides of young leaves, being more prominent on upper sides which gradually enlarge, ultimately enveloping the entire surface and making them turgid. Such leaves break off leaving a barren axis. The uppermost tender leaves appear to be more susceptible to the attack than the older ones. The mildew also affects the growing shoot in advanced cases, and causes severe "die back", ultimately killing it and imparting a blighting effect to the entire seed-bed area.

A powdery mildew caused by *Oidium caricæ* Naock on *Carica papaya* was described from Brazil in 1898 and has been listed by Saccardo.[1] The occurrence of this mildew has also been reported on *Papaya* from Java[2] and the fungus causing it identified as *Oidium caricæ* Naock, evidently on the basis of similarity of spore-character and measurements. A comparison of the *Oidium* spp. on *Carica papaya* reported from Brazil, Java and India in respect of spore

measurements and other morphological features is given in Table I.

TABLE I

Locality	Spore-character	Spore measurement	Authority
Brazil	Elliptical	23–25 × 14·5–20 μ	Saccardo[1]
Java	Elliptical	26·6 × 18·6 μ	Van Overeem *et al.*[2]
India	Barrel-shaped	31–46 × 13·7–23·4 μ	..

It is clear from Table I that Indian *Oidium* is significantly different from the other two *Oidiums* in respect of its spore-characters and measurements and therefore appears to be a distinct morphological species. Unfortunately, no detailed description of the two exotic mildews, especially in respect of the conidiophores, haustoria and catenulation of the conidia, is available for comparison. However, the two characters of the Indian *Oidium, viz.*, shape of conidia and their measurements are sufficiently distinct to justify description of this *Oidium*, as a new species.

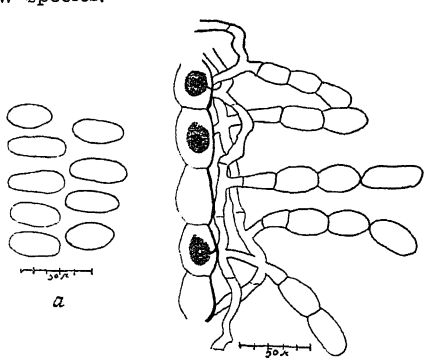


FIG. 1. (*a*) Conidia. (*b*) Section showing haustoria and conidiophores.

Accordingly, it is proposed to describe the Indian *Oidium* on *Carica papaya* as a new species with the following diagnosis:

Oidium indicum: Kamat spec. nov.

Mycelium, ectophytic, hyaline, creeping, 5-7·5 μ in width, forming sparse coating on upper surface of leaves; haustoria more or less globular, penetrate the epidermal cells; measure 16-20 μ in diameter, conidia hyaline, obovate to barrel-shaped, thin-walled, 31·2-46·8 × 13·7-23·4 μ, in chains of 3 to 5. Ascigerous stage absent.

Habitat: on young leaves and shoots of *Carica papaya* L., Poona, India.

The writer is grateful to Prof. M. N. Kamat for guidance and Mr. E. W. Mason of the Commonwealth Mycological Institute, Kew, England, for helpful suggestions.

The specimens have been deposited in the Herbaria of the Commonwealth Mycological Institute, Kew, England, and the Indian Agricultural Research Institute, New Delhi, India.

M.A.C.S. Laboratory, P. P. CHIDDARWAR.
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EPIDERMAL CHARACTERISTICS OF PLANTS IN RELATION TO DROUGHT RESISTANCE

ACCORDING to Keller,[1] Kolkunov[2] and Pavlov[3] the number and the size of stomata determine the drought resistance of plants. Recently Lal and Mehrotra[3] classified varieties of sugarcane as resistant and non-resistant to drought on the basis of the dimensions of stomata and epidermal cells. In the light of these findings an attempt was made to study the relationship between the epidermal characteristics and the drought resistance of barley C. 251 and wheat Pb. 591—the major crops of this tract.

The experiment was conducted during 1949-51. Plants were grown in earthen pots of the size 11″ × 10″ under optimum soil moisture. Twenty-five days after sowing epidermal peelings were taken from the middle of the dorsal side of the second leaf, and fixed between 9 a.m. and 11 a.m. Lloyd's[4] technique was followed for preparing the mounts. To obtain peelings of suitable size, two cuts were made at right angles to the mid-rib. The epidermal surface at one of the cut margins was held by a forceps, peeled off and plunged immediately in absolute alcohol; and prepared as permanent mount. Such mounts were also prepared from 'flag' leaves. Number of stomata and epidermal cells occurring in the same field of the microscope was counted under high power. Stomatal index was calculated from these figures. Dimensions of the cells were measured by a standardised micrometer. The results are summarised in Table I.

TABLE I

Number and dimensions of stomata and epidermal cells in seedling and 'flag' leaves

Crop plants	Stomata			Epidermal cells		
	1949–50		1950–51	1949–50		1950–51
	Seedling	'Flag'	'Flag'	Seedling	'Flag'	'Flag'
		Number per 0·095 sq. mm.				
Barley ..	5·80	9·00	10·50	16·50	20·50	23·50
Wheat ..	4·57	7·00	7·83	14·00	17·00	18·67
		Dimensions (length) μ				
Barley ..	53·79	39·45	36·51	338·4	150·9	126·9
Wheat ..	64·22	48·90	45·64	394·8	201·6	183·3
		Dimensions (width) μ				
Barley ..	6·10	7·07	7·07	22·72	14·44	11·41
Wheat ..	6·52	10·01	9·62	25·96	19·66	18·16
		Stomatal Index				
Barley ..	26·01	30·52	30·89			
Wheat ..	24·58	29·14	29·55			

Barley was characterised by higher frequency but smaller size of stomata and epidermal cells and higher stomatal index as compared to wheat. A similar trend in the results was noted in the 'flag' leaves as compared to the seedling leaves. There was an inverse relationship between the number and the size of the cells.

Newton and Martin[5] stated that the structural modifications of leaves are effective in reducing the water loss during the initial period of drought and in allowing the cells to develop physiological resistance. The inherently superior drought resistance of barley observed by the author may also be due to these epidermal characteristics which create a suitable environment for the physiological adjustment under the stress of drought.

Thanks are due to Prof. N. K. Anant Rao for guidance.

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THE MICRONUCLEI OF *SPIROSTOMUM AMBIGUUM* EHRBG. (PROTOZOA: CILIATA)

MULTIMICRONUCLEATE ciliates are of considerable interest on account of the behaviour of the micronuclei in binary fission and also in conjugation. The intimate relationship that exists between the macronucleus and the micronucleus in ciliates has thrown into sharp focus the differences between them in structure, size, mode of division and function. In all cases where the macro- and micronuclei are single, it is well known that these two nuclei are division products of the synkaryon after conjugation. The differentiation of one into the large and amitotically dividing macronucleus and the other into the small micronucleus which divides by mitosis, are the basic facts noticed in the case of all ciliates where conjugation has been studied. The facts, however, are not so clear in species where the micronuclei are multiple. In cases where the micronuclei are not only multiple but also highly variable in number, the position is even more obscure. The manner in which this variation is produced, the origin of increased number of micronuclei, as well as their diminution at certain stages of their life-history, offer subjects of the utmost interest.

Spirostomum ambiguum is a fresh-water ciliate of large size (1-3 mm. long) with a beaded macronucleus extending almost the entire length of the body. The number of beads is subject to variation in different individuals as well as in different stages of life-history, but does not seem to have any special significance. Ten to fifty beads are common.

The micronuclei are numerous and small but are quite easily visible in Feulgen preparations. They are circular in outline and are flattened disc-like bodies measuring 1·8 μ in diameter. They lie close to the macronucleus and are quite often found inside it. The micronuclear number is subject to great variation. Organisms with as few as ten clearly discernible micronuclei along with those with a hundred micronuclei have been found in my material (Fig. 1). Bishop[1] mentions no specific number found in her stocks but apparently discounts the earlier observations of Maupas[2] and Calkins[3] that the number of micronuclei bears a relationship to the number of macronuclear beads. Finley and Wanza,[4] in their paper on the effect of allyl isothiocyanate on *Spirostomum ambiguum* figure organisms with 4 and 6 micronuclei, suggesting that these are the normal numbers found in the species. My observations are very different. I have never found in my stocks any vegetative animal with less than 10 micronuclei. The average number, found in a count of 50 vegetative animals, was 40.

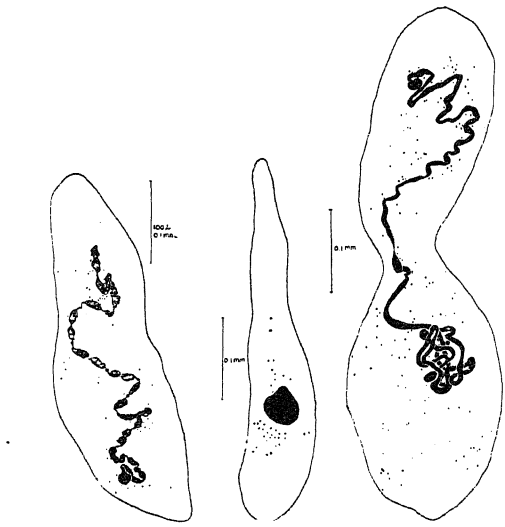


FIG. 1 FIG. 2 FIG. 3

FIG. 1. A vegetative individual of *Spirostomum ambiguum* with macronucleus and a large number of micronuclei. FIG. 2. Stage showing macronucleus in a condensed state. The micronuclei are in telophase. FIG. 3. Binary fission, showing the cylindrical macronucleus and numerous micronuclei in cytoplasm.

The point of interest in regard to the number of micronuclei appears during binary fission. At the approach of division the number of micronuclei is reduced and the number that takes part in mitosis is relatively small. This number too is subject to variation, but is often not more than twenty. There is some reason believe that a much larger number starts mi sis than completes the process.

The macronuclear changes during binary f sion are also interesting. A fusion of the bea and their gradual condensation results in t production of a deeply staining polymorpl body (Fig. 2) which is hollow in the cent Mitosis in the micronuclei is complete at tl stage. The macronucleus now elongates into cylindrical, filamentary body of a more or l uniform diameter, often of great length. transverse furrow appears about the middle the body and the macronuclear filament exten across the furrow and is constricted, as t animal divides into two.

The micronuclear number is lowest at t stage of maximum macronuclear condensatic But as the macronucleus elongates, the micr nuclei start increasing in number and in stage shown in Fig. 3 the micronuclear nu ber is very high.

The manner of this increase is not know Attempts are being made to determine it.

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EFFECTS OF SHORT PHOTOPERIOD ON A VARIETY OF EARLY RICE

SEEDS of an early variety of rice, B. 76 (Puti Shankar) after a preliminary selection for ur formity and then sterilisation were sown December 27, 1952, in seed-bed pots containi a mixture of rice-field soil and cow du manure in the proportion of 9 : 1. Eight-ho short-day treatment (8 a.m. to 4 p.m.) w begun with 15-day old seedlings in the see bed stage on January 12, 1953. The seedlin were transplanted in 10" pots at the rate 4 seedlings per pot on February 1, 1953, ar the same short-day treatment was continu after transplantation till the time of ear emer ence. On the whole there were 42 pots und the short-day treatment with an equal nun ber of pots as control receiving the normal da length in the open space in the pot cultu enclosure. The results of the effects of sho photoperiods on the different aspects of growt and reproduction on this plant are given Table I.

TABLE I

		26-2-1953	5-3-1953	12-3-1953	19-3-1953	26-3-1953	3-4-1953	21-4-1953
No. of tillers per plant	A	1·60	2·05	2·53	2·58	2·62		
	B	2·38	3·34	4·15	4·31	4·37		
No. of leaves per plant	A	4·75	5·15	5·38	5·52	6·28		
	B	3·57	4·09	4·41	4·87	5·89		
Height in cm. per plant	A	34·59	46·01	57·40	64·55	71·95	80·00	106·81
	B	29·18	44·28	51·21	55·76	63·46	72·88	98·03
			Main shoot		First tiller		Second tiller	
Days from sowing to ear emergence	A		111·34		116·19		125·14	
	B		102·74		104·87		107·34	

A—Short-day treated ; B—Controls.

The results presented in Table I indicate that the treated plants take longer time for ear emergence, produce at all stages lesser number of tillers, greater number of leaves and grow taller than the control plants. So far as the delay in ear emergence in this variety is concerned, the result is quite in agreement with those obtained by Misra[1,2] with six early varieties of Uttar Pradesh, *viz.*, T.N. 32, T.A. 64, T. 136, T.N. 22, T.N. 27 and Ch. 10, and by Sircar and Ghosh[3] with two early varieties, *viz.*, Charnock and Panbira of Bengal. However, with some other varieties Sircar and Parija[4] have found no significant difference in the behaviour of the treated ones from the controls as regards the time of ear emergence.

The various responses of the variety B. 76 to the short photoperiod treatment in the present investigation may be explained on the assumption that due to short photoperiods, the concentration of auxin is greatly increased. This increased auxin level may have threefold action, *viz.*, (*a*) promotion of vegetative growth resulting in the production of large number of foliage leaves and greater height of plants, (b) increasing apical dominance to a greater extent with the formation of lesser number of tillers, and (c) an inhibitory action on ear emergence resulting in a delay of 9 days in the main shoot, 11 days in the first tiller and 18 days in the second tiller.

We are thankful to the Utkal University for a grant-in-aid from the Jnan Vijnan Parishad Fund to carry on this investigation.

Dept. of Botany, G. MISRA.
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MODE OF ACTION OF ISO-NICOTINIC ACID HYDRAZIDE (INH)

EVER since iso-nicotinic acid hydrazide (INH) has been developed as an anti-tubercular drug, elucidation of its mode of action has been attempted by many workers. Thus Zeller[1] investigated the action of INH on the bacterial and mammalian diamine oxidase and found that the drug inhibits the enzyme systems. Yoneda and co-workers[2,3] studied the inhibition by the drug of the tryptophanase and amino acid decarboxylase activity of *E. coli* and found that pyridoxine hydrochloride competitively antagonizes this inhibition. However, Boone and Woodward[4] mentioned that the antagonism of the drug by pyridoxine hydrochloride is not competitive. Newberg and Forrest[5] found that INH competes with nicotinamide utilisation by the bacteria. Aronson *et al.*[6] found that INH inhibits the catalase activity of the tubercle bacilli, while Polster[7] could not find any inhibition of the catalse activity in the tubercle bacilli. Barclay *et al.*[8] studying the bacteriostatic action of INH using radioactive isotopes suggested that it might act by interfering with the formation of an essential metabolite. Zatman and co-workers[9] studied the action of INH on diphosphopyridine necleotidase (DPNase) from various sources and suggested that the drug might act through the formation of INH-analogue of DPN. The inhibition of succinic oxidase by this drug has also been reported recently by Arora and Krishnamoorthy.[10]

In this communication, the authors have summarised the results of their studies on the action of this drug on some enzymes, using the Warburg manometric and the circular paper chromatographic techniques. The inhibitory action of the drug as also the sources of the enzymes are mentioned in Table I.

Table I shows that the drug inhibits, among several other enzymes, glutamic acid decar-

TABLE I

No.	Enzyme	Source	Method of preparation	Technique of estimation	Percentage inhibition at various drug concentrations		
					M/1,000	M/10,000	M/100,000
1	Respiration	Tubercle bacilli $H_{37}R_v$	..	Warburg manometric	38·5	23·1	11·5
2	Catalase	Rat liver	Gordon and Quastel[16]	do & titrimetric	64·0	34·0	10·0
3	Succinic oxidase	Sheep heart	Keilin and Hartree[17]	Warburg manometric	57·7	46·2	18·0
4	Cytochrome oxidase	do	do	do	42·3	20·5	7·7
5	Glutamic acid decarboxylase	*Clostridium welchii* SR_{12}	Gale[18]	do	64·5	..	17·8
6	Transaminase	Rat liver	Green *et al.*[19]	do & chromatographic	45·0	10·0	5·0
7	Tryptophanase	*E. coli*	Wood *et al.*[20]	Colorimetric	68·3	61·7	57·5

boxylase, tryptophanase and transaminase, all of which require pyridoxal phosphate as co-enzyme. Yoneda and co-workers[2,3] reporting similar observations with tryptophanase, mentioned that the drug exerts its action by competing with pyridoxal phosphate. *In vitro* studies carried out in this laboratory regarding the antagonism between pyridoxine hydrochloride and INH as also on the anti-tubercular activity of desoxypyridoxine, could not confirm this postulation. Similar results are also reported recently by Boone and Woodward,[4] Biehl and Vilter[11] and Ungar and co-workers.[12]

The inhibition of cytochrome oxidase, succinic oxidase and catalase, by the drug are also noticed from Table I. In view of the chelating nature of the drug,[13] and the recent findings that INH is inactivated by hæmin[14] and by alkaline iron compounds,[15] and in consideration of the above inhibition of the iron-porphyrin system of enzymes, the mode of action of the drug may probably be through the fixing of the iron and thereby inactivating these enzymes.

The authors wish to thank Dr. K. P. Menon and Dr. K. V. Giri for their kind interest in this work. Their thanks are also due to Messrs. Unichem Laboratories, Bombay, for a gift of pure iso-nicotinic acid hydrazide, to Dr. Karl Folkers of the Merck & Co., Rahway, New Jersey, for a gift of pyridoxal phosphate and to Dr J. V. Bhat for the culture of *Clostridium welchii S.R.* 12.

P. R. J. GANGADHARAM.*
M. SIRSI.

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* Lady Tata Memorial Research Scholar.

GYNANDROMORPHISM IN *CULEX FATIGANS* WIED.

GYNANDROMORPHISM has been reported in the mosquito, *Culex pipiens-quinquefasciatus* and *Culex quinquefasciatus* by Middlekauff.[1] Rings[2] has made a record of a gynandromorph specimen of *Culex nigripalpus* Theobald, which exhibited the male type of antennæ and palpi and the female type of abdomen and genitalia. Margaret and Samuel[3] have reported the find of another specimen of *C. nigripalpus*, which possessed a typical female type of antennæ and palpi and a male type of abdomen and genitalia. It is the object of the present note to draw attention to another similar case of gynandromorphism in a species of *Culex*.

In these laboratories, a colony of the mosquito, *Culex fatigans* Wied., originally raised from[4] an egg raft of a gravid female brought from the field, has been maintained since September 1945. An average of 500 adult mosquitoes emerging from this colony were examined daily and the females were separated from the males for eventual use as test insects in the bioassay of insecticides. For the first time, a specimen of this species of mosquito exhibiting gynandromorphic characters was observed on 13-1-1955. It possessed the female type of abdomen and genitalia and antennæ and palpi of male pattern as will be seen from Fig. 1.

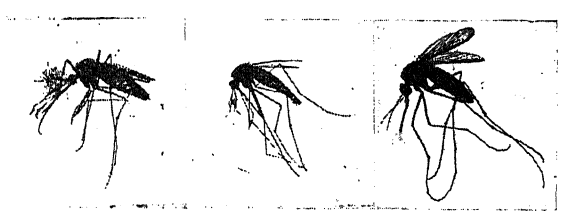


FIG. 1 FIG. 2 FIG. 3

FIG. 1. Gynandromorph specimen of *Culex fatigans* Wied. FIG. 2. A typical male of *Culex fatigans* Wied. FIG. 3. A typical female of *Culex fatigans* Wied.

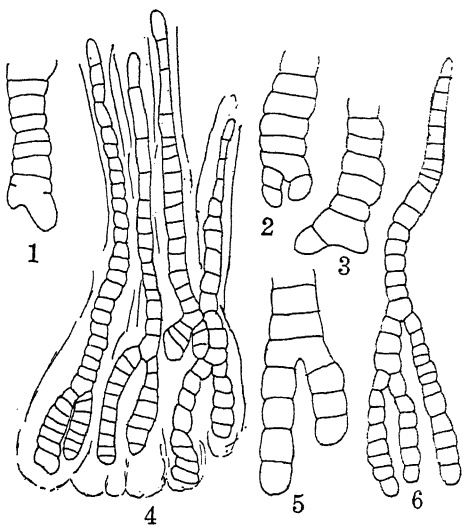
For comparison, Figs. 2 and 3 show typical characters of a male and a female, respectively.

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OCCURRENCE OF *IYENGARIELLA TIRUPATIENSIS* DESIKACHARY AT PACHMARHI HILLS

DURING a visit to the Pachmarhi hills (Madhya Pradesh) in October 1951, the authors collected an alga which agreed very closely with *Iyengariella tirupatiensis* which was described by Desikachary[1] from Tirupati in S. India. The alga has therefore been referred by them to this species.



FIGS. 1-6. *Iyengariella tirupatiensis* Desikachary (FIGS. 1, 2, 3, 5 × 478; FIGS. 4, 6 × 290.)

The alga formed a thick crustaceous growth on the bed of a fast-flowing hill-stream at Pachmarhi. The individual filaments showed a more or less parallel arrangement, with two distinct portions, a lower creeping branched one and an upper erect unbranched one terminating in hairs. The alga showed true lateral branching and also pseudodichotomous branching. Heterocysts were absent in the alga. The filaments were 12·8-16 μ broad at the base. The trichomes were 4·8-9·6 μ broad in the basal portion and 2-3 (— 6·4) μ broad in the apical hair-portion. The cells were 3-4 μ long in the lower portion and 4·8-6·4 μ long in the upper portion. While the alga thus agreed with the Tirupati form in most respects, its branching, however, was comparatively more sparse, and its hairs also were not so long as in the case of the Tirupati form. These differences may perhaps be attributed to the very strong current in which the alga was growing at Pachmarhi.

This is the second record of this very rare and interesting alga in our country.

Saugar University, Sagar, T. V. DESIKACHARY.
April 12, 1955. L. P. MALL.

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PRESERVATION OF BUFFALO SEMEN IN GLYCINE BUFFER

IT is common knowledge that the conception rate of artificially inseminated buffalo cow is very much lower than that of cows; also the percentage of conception rate in naturally served animals is higher than those inseminated artificially. It appears that this low conception rate is related to the poor keeping quality of diluted buffalo semen in citrate buffer. Recently it was demonstrated that the livability of the spermatozoa of a number of species (bull, boar, stallion and ram) is vastly improved in medium composed of glycine and egg yolk.[1-3] In the course of our investigations it was found that the total life-span of buffalo spermatozoa is markedly prolonged in the above medium.

Buffalo semen was diluted with glycine-egg yolk (prepared by mixing equal volumes of 4% glycine and egg yolk), in the proportion of 1 part of semen to 5 parts of glycine-egg yolk. The life-span of the spermatozoa has been shown in Fig. 1. It will be seen that whereas

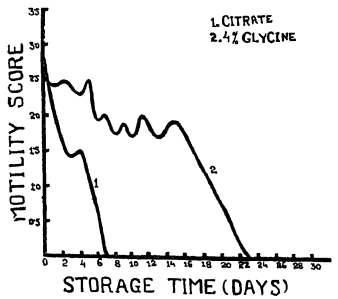


FIG. 1. Mean observation on the decline of motility of spermatozoa in nine split ejaculates diluted in (1) 3·6% sitrate-egg yolk, and (2) 4% glycine-egg yolk and stored at 4° G.

the motility of the spermatozoa in citrate buffer declines very rapidly, it remains high in glycine-egg yolk for about 2 weeks and the total life-span is very markedly prolonged.

An insemination trial carried out with bull semen preserved in this medium had shown that the conception rate is slightly better than that obtained with semen preserved in citrate.[4] We have not yet been able to carry out any fertility test with buffalo semen preserved in glycine but it can reasonably be expected in view of the results obtained with bull semen that such preserved buffalo semen samples would be fertile.

Dept. of Physiol. and Biochem., A. ROY.
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Mathura (U.P.),
May 2, 1955.

1. Roy, A. and Bishop, M., *Nature*, 1954, **174**, 746.
2. Roy, A., *Vet. Record*, 1955, **67**, 330.
3. Ahmed, S. I. (Personal Communication).
4. Roy, A. and Bishop, M. (Unpublished data).

THREE UNRECORDED COCCIDS ON GRAPE VINE (*VITIS VINIFERA*: N. O. AMPELIDAE)

1. *Laccifer lacca* Kerr. (Homoptera: Lacciferidæ)

A GRAPE VINE, *Vitis vinifera*, infected by lac, was found in a private garden in Ranchi in February 1955. The grape vine, *Vitis vinifera*, was infected with the *Rangeeni* strain of *Laccifer lacca* Kerr. The vine bore lac insects of the *Katki* crop (June-July to Oct.-Nov. 1955) and also the current Baisakhi crop (Oct.-Nov. 1954 to June-July 1955). The lac insects had settled on the branches of the climber measuring ¼-½" in diameter. The average number of young lac insects per linear inch was 165. The ratio of females to males being 1 : 2. The source of infection seems to have been accidental through the agency of birds, bats, squirrels or wind from lac-bearing *ber* (*Zizyphus mauritiana*) or *Sharifa* (*Anona squamosa*) trees situated at a distance of about 15' from the grape vine.

2. *Aonidiella orientalis* Newst. (Syn. *Aspidiotus orientalis* Newst.) (Homoptera: Diaspididæ).

This scale insect was found in various stages covering practically the whole of climber and may be considered as a serious pest of grape vine (*Vitis vinifera*). Emergence of larvæ was observed from two females.

3. *Icerya ægyptiacum* Doug. (Homoptera: Coccidæ)

Only two females of this scale insect were found on the climber. Emergence of larvæ was observed from one of them.

My thanks are due to Shri S. K. De, for drawing my attention to the lac-infected grape vine and to Mr. B. K. Purokayastha, Arboricultural Assistant of this Institute, for determining the specific name of the grape vine.

Entomological Section, B. P. MEHRA.
Indian Lac Research Institute,
Namkum, Ranchi,
March 31, 1955.

REVIEWS

6-Mercaptopurine. By George H. Hitchings and 84 other scientists. (Annals of the New York Academy of Sciences, Vol. 60, Art. 2), 1954. Pp. 183-508. Price $4.5.

The monograph presents a review of the present knowledge of 6-Mercaptopurine and opens with a discussion of the biosynthesis of nucleic acids as a background for discussion of the possible modes through which 6-Mercaptopurine may act. Its action on embryonic tissue is discussed by Bieber *et al.* who state that the activity is presumably directed against relatively undifferentiated cells. Thiersch using rats as experimental animals finds the most sensitive period of the fœtus to the drug to be the time of implantation and 24 hours thereafter, *i.e.*, the 7th and 8th day of gestation. Effects of 6-MP on tumours in tissue culture are reported by Biesele. 6-MP is able to suppress cell division to a variable extent. In some neoplastic cell strains the mitotic inhibition is more pronounced than in several normal tissues tested. Its effect on experimental tumours in mice is described by Clarke *et al.* 6-MP inhibits the growth of sarcoma 180, prolongs the survival time of the host animal and causes a certain number of animals to recover from the tumour.

Several papers discuss the effect of 6-MP on experimental leukemia. 6-MP inhibits leukemic cell growth of leukemia L 1210 and several other lymphocytic leukemias. Experiments to determine whether specificity of action of 6-MP with respect to leukemia is a fixed characteristic of the drug or whether it may be altered by the manner in which the drug is employed are discussed by Goldin. He finds it possible with aminopterin and A-methopterin as well as with 6-MP to increase the antileukemic specificity of the drugs by employment of appropriate schedules of treatment.

Toxic effects of 6-MP in mammal studied by Philips *et al.* concern the potential hazards in therapeutic application. The effects are noted as damage to bone marrow, intestinal epithelium, disturbances in hepatic function and the possibility of liver necrosis.

Preceding the discussion of the clinical application of 6-MP is a most valuable, detailed review of the natural history of untreated acute leukemia by Tivey. He reviews and correlates all relevant available publications on this disease and includes a bibliography of 228 papers on leukemia.

Clinical studies with 6-MP are discussed in 24 papers. The largest series on the clinical use of 6-MP is reported by Burchenal *et al.* who used it on 269 patients having various forms of neoplatic diseases. They discuss in detail mode of administration and clinical experience. A high percentage of remission was achieved with 6-MP in the early stages of myelocytic leukemia. It may cause remissions in patients resistant to A-Methopterine or cortisone. Hall's experience with the drug in acute leukemia is that an initial remission rate of 54% of the 24 adult patients was achieved. This initial remission rate is higher than those reported with folic acid antagonist or hormone therapy. Bernard and Seligmann from Paris treating 61 leukemias come to the conclusion that 6-MP therapy is indicated in cases of myeloblastic attack of chronic myeloid leukemia and in cases of acute leukemia resistant to other forms of therapy. Farber in his summary of experience with 6-MP reports that it produces hematological improvement in 50% of patients with acute leukemia; this improvement represents one-third complete remission and two-thirds hematological improvement. In his experience no patient responded to 6-MP who had failed to respond previously to cortisone and/or FAA. Combined therapy with cortisone and/or FAA shows no advantage over the use of single agents. The leukopenia encountered during 6-MP therapy does not always indicate drug toxicity but may represent an early phase of response to therapy. Most of the other papers report on smaller series of clinical evaluation of 6-MP and corroborate the above findings. This symposium gives a valuable summary of the knowledge available on the action of 6-MP in the laboratory and clinic.

HANNAH PETERS.

Introduction to 3-D. By H. Dewhurst. (Chapman & Hall), 1954. Pp. 152. Price 21 *sh.* net.

This is a small but comprehensive book dealing with all aspects of three-dimensional photography in motion pictures with chapters on wide-screen, cinemascope, cinerama and

stereo-television. The author is a research physicist and producer of films who has himself been responsible for a new form of single film stereo, and the book provides an instructive combination of basic theory and of its practical application which should be of keen interest to the amateur and professional alike.

After an exhaustive study of the monocular (movement, accommodation, perspective) and the binocular factors (convergence, parallax) in the perception of depth, the author studies the geometrical requirements which have to be fulfilled for "natural vision" and the corresponding projection requirements and methods. Various viewing aids such as integrating screens, shutter-occluding, anaglyphs, and the use of polarised light are described and then the author takes up various projection methods. In particular, the rotational beam splitting method—"a laboratory pre-occupation of the author for many years"—in which the left and right eye pictures occupying the two vertical halves of a frame are rotated each through a right angle by a prism system so as to give the usual horizontal format is discussed in some detail. The various distortions which occur and their corrective methods are studied, and the advantages of the wide screen and etereoscopic projection compared. A very useful book, which could be read with profit by those interested in the subject.

A. NARASINGA RAO.

The Lipids. (*Their Chemistry and Biochemistry*), Volume II: (*Biochemistry; Digestion, Absorption, Transport and Storage.*) By Harry J. Deuel, Jr. (Interscience Publishers, Inc., New York), 1955. Pp. xxvi + 919. Price $ 25.00.

This book is the second volume in the series by the author on the lipids. The chemical approach to the subject is covered exhaustively in Volume I published in 1951. The present volume includes all available information on the digestion, absorption, transport (in the blood and lymph), and storage of fats and other lipids in the animal body. Volume III is to deal with biosynthetic, metabolic and nutritional aspects of the subject. The recent spectacular progress in these latter fields has necessitated this expansion in the scope for the biochemical topics being discussed in *two* volumes.

The contents fall into six sections dealing respectively with (*i*) the digestion and absorption of fats in the gastro-intestinal tract; (*ii*) the methods for the study of digestibility of lipids and various factors altering this digestibility; (*iii*) the digestion, absorption and digestibility of lipids other than fats, *viz.*, phospholipids, waxes, higher aliphatic alcohols, sterols, hydrocarbons, carotenoids, and fat-soluble vitamins; (*iv*) blood lipids, including the site of synthesis of plasma lipids and its turn-over—a subject of great importance in the study of arteriosclerosis and atherosclerosis; (*v*) the occurrence of lipids in different animal species, including a consideration of such subjects as storage of lipids under abnormal conditions, classification of fatty livers, and the role of lipotropic factors; and (*vi*) the distribution of lipids in specific tissues such as liver, kidney, brain, muscle, spleen, and the reproductive organs.

Although the monograph is concerned chiefly with the biochemical phases of lipids, some topics of a more chemical nature have been included such as the description of the chemistry and structure of bile acids which, of course, must be understood to ensure proper comprehension of the controversial subject of fat absorption.

This book is in many ways an excellent compilation and few, if any, could have attempted such an ambitious task as well as Professor Deuel has accomplished. Each chapter is a vast array of carefully organised and essential data with interpretations that are remarkable for their clarity and accuracy alike. The value of the book is enhanced by the up to date references to literature, compact tables, illustrated graphs and photographs. Professor Deuel has continued detailing the generic names of plant and animal sources, in addition to the author- and subject-indices as in Volume I. This treatise will, for many years, be an indispensable aid for study and reference to workers in the field.

Although priced rather high, praise is due for the infallible print and for the good quality paper used.

S. M. PATEL.
A. SREENIVASAN.

Methods of Biochemical Analysis, Vol. II. Edited by David Glick. (Interscience Publishers, Inc.), 1955. Pp. vi + 470. Price $ 9.50.

The volume under review is the second in the series of *Methods of Biochemical Analysis* edited by David Glick and follows closely the pattern set in the first volume published in 1954. There are 13 articles on different biochemical methods, in many of which novel experimental techniques developed in recent years have been

employed, and have been written by authors well known for their contribution towards the development or perfection of these methods. Thus, for instance, W. M. Sperry discusses the methods of lipid analyses, T. A. Jukes on assay of compounds with folic acid activity, G. D. Novelli on methods for the determination of coenzyme A, Z. Dische on new colour reactions for the determination of sugars in polysaccharides, and R. J. Winzler on determination of serum glycoproteins.

Special mention may also be made of the chapters on recent developments in techniques for terminal and sequence studies in peptides and proteins, the spectrophotometric assay of cytochrome C oxidase and the analysis of steroids by measurement in the infrared region. Dr. R. W. Lehmann has written on the determination of vitamin E in a style very different from that in which the other articles have been presented, and this may prove difficult for some to comprehend its full significance. The article on determination of glutathione by J. W. Patterson and A. Lazarow appears to be repetition of details contained already in the symposium on glutathione published in 1954, and Editor Glick could very well have given in its stead a method of biochemical analysis based on tracer technique. However, on the whole, one gets the impression that the different methods chosen have been very timely in this annual series, and that the methods have been presented in great detail as to be easily applied in the solution of many biochemical research problems.

A remarkable feature noticed on going through this volume is the manner in which the ultraviolet spectrophotometer has been pressed into service in so many of the recently developed methods. The get-up of the book is excellent and there is a subject as well as an author index in the end. The volume can confidently be recommended to those who wish to keep themselves up to date with the various methods and techniques in biochemistry.

P. S. SARMA.

Gas Dynamics of Thin Bodies. By F. I. Frankyl and K. A. Karpovich. (Translated from Russian by M. D. Friedman.) (Interscience Publishers, Inc.), 1953. Pp. viii + 175. Price not given.

The original monograph in Russian was intended to bring together, for more widespread circulation, the latest work on the formulization of linearized problems of compressible flow theory and the methods of their solution. At the time of its publication in 1948, these methods could only be found in the literature. The text, in fact, included an exposition of the method of solving the problems of supersonic flow over wings of finite span which is usually credited to J. Evvard. An English translation, therefore, seemed highly desirable.

The monograph consists of five chapters, the first of which contains a section describing the achievements of Soviet mathematicians. The later work refers to Western as well as Russian aerodynamicists who did pioneer work in solving the particular problems.

Chapter I contains a short survey and basic formulation of the problem with a method of solving the differential equation. Chapter II treats rigorously and in detail the compressible flow around bodies of revolution. Chapter III reviews work done before on wings of infinite span, in steady motion, compares linearised theory of bodies and wings, and introduces the new method of Mme. Krasilschikova (J. Evvard). Chapter IV treats unsteady flows and applications to the problems of supersonic propellers. Chapter V lists another method of solution, that of conical flow fields.

The volume will be highly useful to engineers, students in aerodynamics, and applied mathematicians in their study of the linearized problems of compressible flow theory. It should certainly make a fine text-book for a one-year special course in linearized supersonic aerodynamics.

Technical Publications. (*Their Purpose, Preparation and Production.*) By C. Baker. (Chapman & Hall), 1955. Pp. xiii + 302. Price 36 *sh.*

The dividing line between scientific and technical publication is perhaps a very useful one indicating that while the value of the former depends upon the quality of scientific imagination, that of the later derives from the art of presentation. Technical publications—there are a variety of them extending from books to mere reports—serve the very useful purpose of presenting the results of research in a form amenable for development and industrial production. Their authorship naturally involves something of a technique, and this is sought to be supplied in the book under review.

The preliminary chapter on the forms of technical publicity introduces the would-be author to the variety of publications he may be called upon to handle. The next three chapters contain copious hints of a practical nature on the elements of authorship. Nearly 80 pages

are devoted in the course of two chapters to emphasise the value of illustrations. This is obviously a little overdone, considering that neither charts nor tabular statements receive much attention. The next two chapters deal with the technique of production and give useful hints on preparing the copy for the press, and proof correcting. The last two chapters on giving and getting aircraft and allied information and legal documents seem a little too specialised to need inclusion in a book of this nature.

The volume is bound to be useful to engineers, chemists and physicists and all others who have to assume the responsibility of authorship in any degree. But the definite impression remains that the value of the book will be much enhanced by a little judicious condensation.

Fishing Boats of the World. Editor: Jan-olaf Traung. (Published by the FAO.) (Arthur J. Heighway Publications, Ltd., London, E.C. 4), 1955. Pp. xx + 579. Price $ 12.5.

Fishing Boats of the World deals with that part of fishing boat design which is missing from all text-books on naval architecture, and it provides, under one cover, a wealth of material contributed by architects, designers, engineers and other experts of more than a score of different countries, and it forms a valuable guide and reference work for all those in the fishing boat building industry.

The comprehensiveness and diversity of material in the book reflects the present knowledge in the industry and should advance intelligent application of the principles of naval architecture to the design of fishing boats.

Apart from the chapter dealing with research vessels, there are sections on boat types, materials, economics, naval architecture, safety at sea, engines, deck gear and factory ships. Each subject is covered comprehensively. For example, in the boat type section, various authors deal with short distance, surface, bottom and combination fishing. Under these headings they discuss critically the design and construction, qualities and defects of scores of boats from many countries. The boats examined range from dug-out canoes and beach landing craft up to the most intricate and advanced deep sea trawlers.

As Dr. D. B. Finn, Director of Fisheries Division, FAO, points out in his Foreword to the book, little has been done in the past to improve the design and construction of fishing vessels generally and the experts who have contributed to this book are in agreement that it is time for science research and experiment to aid the fishing boat builder. Many contributors, especially the American experts, have dealt most frankly with failures in design, construction, and operation of a number of fishing craft through ignorance of 'sound principles of naval architecture' or through indifference to them.

Books Received

Organic Solvents—Physical Properties and Methods of Purification—Technique of Organic Chemistry, Vol. VII. Edited by Arnold Weissberger. (Interscience Publishers, Inc.), 1955. Pp. vii + 552. Price $ 8.50.

Preparation and Assay of Enzymes—Methods in Enzymology, Vol. I. Edited by Sidney P. Colowick and Nathan O. Kaplan. (Academic Press, Inc.), 1955. Pp. xxv + 835. Price $ 18.00.

Experiments in Organic Chemistry. Third Edition. By F. Fieser. (D. C. Heath & Co., Boston), 1955. Pp. 368. Price $ 5.25.

Transactions of Symposia in Applied Mathematics, Vol. II. (Interscience Publishers, Inc.), 1955. Pp. 216. Price $ 5.00.

Bird Navigation—Cambridge Monographs in Experimental Biology, Vol. III. By G. V. T. Matthews. (Cambridge University Press), 1955. Pp. vi + 140. Price 12 *sh.* 6 *d.*

This Age of Science. By E. J. Rowland. (Macmillan & Co., Ltd.), 1955. Pp. 125. Price 4 *sh.* 6 *d.*

Electrical Characteristics of Overhead Lines. By S. Butterworth. (The Electrical Research Association, Dorking Road, Leatherhead, Surrey), 1954. Pp. 238. Price £ 2-2-0.

The Distribution of Sagitta Gazellæ Ritter Zahanoy—Discovery Reports, Vol. XXVII. (Cambridge University Press), 1955. Pp. 235-78. Price 15 *sh.*

Leukocytic Functions—Annals of the New York Academy of Sciences, Vol. LIX, Art. 5. (New York Academy of Sciences), 1955. Pp. 665-1070.

Polarographic Techniques. By Louis Meites. (Interscience Publishers, Inc.), 1955. Pp. xiii + 317. Price $ 6.00.

The Nucleic Acids, Vol. II. Edited by Erwin Chargaff and J. N. Davidson. (Academic Press, Inc.), 1955. Pp. xi + 576. Price $ 14.50.

Oil Equipment in Europe. (Organisation for European Economic Co-operation, Paris-16), 1955. Pp. 136. Price $ 1.25.

SCIENCE NOTES AND NEWS

A Simple Infrared Grating Spectrometer for use in Analysis

A simple infrared spectrometer has been designed by the U. K. Atomic Energy Authority specifically for use as a laboratory analytical tool. A Merton-N.P.L. replica grating is used as the dispersive medium, obviating the need for accurately figured mirrors yet giving resolution adequate for most analytical purposes. Additively coloured alkali halide crystals, which were specially developed for the purpose, are used to filter out unwanted spectral orders. Although capable of handling a wide variety of analytical problems, this prototype instrument was designed specifically to cope with the analysis of heavy water. With it the D_2O content of heavy water in the 99·5 to 100% range can be estimated with an accuracy of 0·003%. (*Royal Society Converzatione*, May 19, 1955.)

High Altitude Research at Gulmarg

A symposium on High Altitude Research sponsored by the National Institute of Sciences of India was held at Gulmarg during May 27-28, in collaboration with the Gulmarg Research Observatory. The symposium organised by Prof. P. S. Gill, was well attended and the panel of speakers included Drs. K. R. Ramanathan, S. K. Mitra, K. S. Krishnan, B. Peters, R. C. Majumdar, L. C. Verman and many others. In all, about 70 original papers were presented. The deliberations will be published in the form of a bulletin by the National Institute of Sciences of India.

Vapour Phase Chromatography

When a mixture is vaporized and the vapour is swept over a suitable static liquid phase, on an inert support, the components may travel at different rates depending on the boiling point and relative solubility in the static phase; as they emerge from the column the fractions are detected by thermal conductivity cells connected to a recorder. With suitable apparatus, very small samples can be analyzed rapidly and more completely than ever possible by distillation.

Exhibits presented at the Royal Society Conversazione—19 May 1955 by the Billingham Division, Imperial Chemical Industries, Ltd., show the analysis of a gas mixture at room temperature, of a low boiling liquid at 60° C. and of homologous long chain fatty acid esters and alcohols at about 250° C. Each exhibit emphasizes certain aspects of this new analytical method, which is rapidly becoming one of the most valuable analytical methods in the organic chemicals industries.

Improved Recording Spectrophotometer

According to an announcement from the Applied Physics Corporation, Pasadena, California, the Cary Model 14 Recording Spectrophotometer provides good performance to 1900 Å and even shorter wavelengths, through the use of optical elements of increased ultraviolet efficiency in the prism grating double monochromator. This region includes analytical possibilities for ketones, alcohols, monoolefines, aromatics and several other compounds. Formerly, good performance below 2100 Å was possible only on custom-made instruments.

Although the prism grating double monochromator of the Model 14 has been known for its unusually high resolving power with low scattered light (less than a part per million) in the ultraviolet, visible and near infrared regions, the improved optical elements make it even more effective and provide the extended range, according to the manufacturers.

New Medium for Telephone Transmission

A new and radically different medium for transmitting television and telephone conversations over long distances has been used successfully in experiments at the Bell Telephone Laboratories recently.

Waveguides made of solid metal tubing—roughly like a metal water pipe—have been widely used for some time for short distances. It would be possible to use these solid metal tubes for long distances if they were perfectly straight, but this is impractical. The new long distance waveguide is also a hollow tube, but it is constructed of thin copper wire, very tightly coiled—like a spring under pressure—and wrapped inside a flexible outer coating which holds the coiled wire in place. This type need not be straight and can actually carry signals around corners.

Experiments indicate that both the solid tube type waveguide and the new coiled wire or "helical" type of waveguide can be used together in communications systems, the first for short distances and the latter for long distances. The carrier frequency for the new

waveguide is about 50,000 megacycles. A major difference between transmission through the new waveguide and through previous systems is that the higher the frequency in the waveguide, the less the loss through attenuation. This is exactly the reverse, in other forms of transmission.

International Exhibition of Laboratory Equipment

The First International Exhibition of Laboratory Equipment (Science and Industry) will be held from 10 to 25 September 1955 under the auspicious of the Fédération des Industries Chimiques de Belgique and Société Chimique de Belgique. The Exhibition will be a part of the International Fair at Gand, Belgium. Those interested may obtain further details from Le Commissaire-General, Ing. Marcel De Cavel, Foire International De Gand, Palais des Floralies, Gand, Belgium.

Raptakos Fellowships for Medical Research

The Raptakos Medical Research Board will consider applications for the award of fellowships for research work on medical and allied subjects in recognized institutions situated in the Union of India. The awards normally consist of Rs. 3,000 per year for a Fellowship and Rs. 750 per year towards special equipments or chemicals approved by the Board.

Applications in the prescribed form (which may be obtained from the Secretary and Treasurer, Raptakos Medical Research Board, Dr. Annie Besant Road, Worli, Bombay 18), should be submitted before September 30, 1955, for grants commencing from January 1, 1956.

Colonel Amir Chand Trust Prizes for Medical Research

It has been decided to award during 1955 six prizes of the value of Rs. 300 each for the best published research work in any subject pertaining to all fields of medical sciences including clinical research, published by workers during the year 1954 (1st January to the 31st December 1954). The award of the prizes will be announced by the Indian Council of Medical Research, during November/December 1955.

The candidates are required to submit 15 reprints of their papers published during 1954. These should be sent to the Secretary, 'P' Block, Raisina Road, New Delhi, so as to reach him not later than the 1st September 1955. The papers should be accompanied by a short biographical sketch and two copies of passport size photographs of the worker or workers concerned.

New Source of Reserpine

C.S.I.R.O. Melbourne announce the occurrence of Reserpine in the bitter bark of *Alstonia constricta*, an Australian tree. (Reserpine is used in the treatment of high blood pressure and hypertension and is scarce throughout the world). *Alstonia* species exist over a large area of North-East Australia.

Current Ratings for Cables

The Electrical Research Association has released for publication a technical report on Current Ratings for Paper-Insulated Cables to B.S. 480: 1954 and Varnished-Cambric-Insulated Cables to B. S. 608 : 1955. The report covers the revised edition of B. S. 480 : 1954, including aluminium-sheathed cables. It takes account of the higher operating temperatures for certain cables which are now permissible by agreement with the Cable Makers' Association. The price is 5 *sh.* Limited supplies of this report are available from the Association at Thorncroft Manor, Dorking Road, Leatherhead, Surrey.

Award of Research Degree

The Ph.D. Degree of the University of Poona has been awarded to the following: Shri Shriram Vishwanath Pingale for his thesis entitled (*i*) Studies on Insect Damage in Stored Staple Foodgrains at Three Centres in Bombay State; (*ii*) Biology and Morphology of *Opatroides vicinus* Fairm.; and to Shri Raj Harkisan Dunichand, for his thesis entitled "Detailed Study of Essential Amino Acid Content in the Milk of Indian Buffaloes".

Indian Council of Ecological Research

The Indian Council of Ecological Research at the Forest Research Institute, P.O. New Forest, Dehra Dun (India), is attempting to build an Ecological library. The Council trains teachers and post-graduate students in Ecological Research from Indian Universities and offers facilities to research workers for carrying on original work and in consulting Ecological works. Publishers of Ecological books, Ecological Societies and Ecologists are requested to help generously by sending as many of their publications as they can spare. Contributions will be gratefully received by Secretary of the Council: Dr. G. S. Puri, Ecologist, Forest Research Institute, Dehra Dun (India).

ERRATUM

In the review on 'Chemical Pathways of Metabolism', (1955, 24, 213, column 1) *read* heme *for* leme.

980 55 Printed at The Bangalore Press, Bangalore City, by C. Vasudeva Rao, Superintendent, and Published by A. V. Telang, M.A., for the Current Science Association, Bangalore.
Editor: Prof. G. N. Ramachandran, A. C. College of Technology, Madras 25

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FURTHERANCE OF BASIC RESEARCH*

THE concept "basic research" may comprise the systematic endeavour, without preconception, to increase our knowledge and understanding of nature. It is the kind of research that some would characterise as "pure science". If it is indeed pure, it derives that quality from uncompromising objectivity, unconcern over specific aims, and absence of intent to exploit results. It is intellectual adventure: a hunting expedition in unexplored domains where the weapons are the experimental devices and aids to observation by which data are gathered, processed, and made ready for interpretation. The trophies of the hunt are new concepts and principles. They are freely shared, through publication, with all who are interested in them.

For the most part, basic research is conducted by scientists in faculties of colleges and universities. Much research that is sometimes called basic is carried on within government-owned and government-operated as well as industrial laboratories. Such research may lack the above-mentioned purity because it gets an occasional nudge, or at times even a strong push, in the direction of the practical interests of the supporting agency or industry, but it is difficult to separate the above kind of research from all that appears under the category "basic".

Role of Government

Since Government is already deeply involved in basic research, it would be academic at this point to argue that it should or should not be so involved. But we may properly discuss

* Based on three articles by Paul E. Klopsteg, Monroe E. Spaght and Kenneth S. Pitzer, presented by the authors at the Symposium on 'Roles of Government, Industry and the University in Basic Research' (*Science*, 1955, **121**, 781).

whether more or less Government money should go into basic research. Is it possible to devise a better policy? Can the role of Government be altered in a desirable way? This is a large question. It deserves examination. In response to the question "Why is Government involved in basic research?" it may be said without reservation that the underlying motivation of the Government in science is the utilization of science. If this appears to be in conflict with our definition, we may take note that if basic research requires justification, it is justified by the experience that new knowledge of science has great potential value to society. Such value comes from eventual utilization. At any rate, this is the argument that must be made to bureaus and legislative committees to justify budgets and appropriations.

In this context, there is an important role in basic research for an enlightened government: to devise ways and means by which vastly larger funds are made to flow to our institutions of higher learning from a great diversity of sources. Funds should come not only from corporations but from the great number of private citizens who are potential donors to such causes. It is here, in the tapping of this source, that Government can play an exceedingly important role in the support of basic research and education. Only Government can bring about a large yield of funds from this source. It can do this by making it possible for the individual to give, at nominal or no cost of giving.

But it is clear that the Government has at present an important role in supporting basic research by providing funds for the conduct of such research in the laboratories of its own agencies and, in emergencies, for the procurement of research and development services from non-government agencies. It must also make grants and contracts under which educational institutions may support the work of research scientists on their faculties. Government also has now a responsibility with respect to increasing the numbers of qualified research scientists. Prospectively, Government will have to finance indefinitely the large projects of team research that involve annual budgets quite in excess of the financial resources of any institution.

Basic Research in Industry

One recent study indicates that of the total research expenditures in the United States, about 65% is spent in industrial research laboratories. The industry programmes employ more than one-third of all the people engaged in research. To see where basic research fits into the scene, we should consider the main kinds of research being carried out in industry. We have pure research, which may be defined as the inquiry after knowledge for its own sake, without consideration or hope of practical gain. We also have applied research, the investigation carried out in response to immediate, direct, and obvious needs. Basic research is in between.

Despite the lack of pressure, the movement in industry toward more elaborate programmes of basic research has been remarkable. Even though we knew 20 years ago that the great technological advances in industry would require a great deal of research, we could hardly have predicted then that industrial concerns would today be sponsoring programmes as large as those that exist at present.

This has happened for a very good reason. It has paid off. It will continue only so long as it continues to pay off. Although altruistic reasons may be involved in some programmes of basic research, and although industry is increasing its support of study aimed at the long-term social benefit of all mankind, it must be understood that when we talk about basic research in industry today, we talk about an undertaking that is made primarily for the economic advantage of the sponsoring agency. However, it must be remembered that no matter how able the scientists may be, how well equipped the facilities, how diligent the staff, one can never guarantee results. If there is anything certain about research it is this—one may include here pure, basic, and applied research for this confident generalisation—not all efforts will succeed, some successes will never make a profit, and nothing is sure until the work has been done. Thus, an attempt to relate investment in basic research to the specific parameters of the development and capital abilities of an isolated company requires that the investment be large enough to play on the laws of probability. It is obvious that a single venture in basic research can yield nothing; alternatively, it could by chance yield such a wealth of new ideas that the corporate facility for its application would be completely inadequate. This problem becomes less important, the larger the organization, and it disappears completely in a venture the size of a national economy.

Role of the University in Basic Research

The role of the Universities is to perform a large portion of the basic research and to train

virtually all the men engaged in research. Most of the basic research has been conducted in the Universities in the past, and obviously this should and will continue to be the case. The mission of the University is to create and transmit knowledge. This aim is parallel to the aim of basic research; consequently there is no possible conflict of purpose when basic research is carried out at a University.

From another aspect the University offers the ideal setting for research. The strongest human driving force in basic research is curiosity. H. L. Mencken wrote:

> The value the world sets upon motives is often grossly unjust and inaccurate. Consider, for example, two of them: mere insatiable curiosity and the desire to do good. The latter is put high above the former, and yet it is the former that moves one of the most useful men the human race has yet produced: the scientific investigator. What actually urges him on is not some brummagem idea of Service, but a boundless, almost pathological thirst to penetrate the unknown, to uncover the secret, to find out what has not been found out before. His prototype is not the liberator releasing slaves, the good Samaritan lifting up the fallen, but a dog sniffing tremendously at an infinite series of rat-holes.

It is therefore a matter not only of getting an adequate amount of money into the University's operation but of handling this amount of money in a fashion that does not hamper the basic character of the work. In other words, the funds that finance research should be available in a manner that does not restrict the operation of the investigator. The funds for University research can best come from normal University budgets, that is, from the same general budgetary framework that includes the salaries of the members of the professorial staff and their non-professorial assistants as well as the funds for chemicals, or materials for the machine shop or the glass-blowing laboratory, and so forth.

Unfortunately, however, the usual University budgets are inadequate even for the present level of basic research, and they have had to be supplemented by funds from various grants or contracts, which in turn have tended to put one boundary or another on the manner of use. The aim ought to be to increase the amount of money coming through regular channels in University operations rather than continually to multiply the varieties of routes through which these funds arrive.

Whether it is feasible for the Government to use a different type of distribution or not, it is clear that the Government should see to it that University research is adequately financed, not necessarily that the Government finance it directly. If steps can be taken to cause adequate funds to flow into University channels from private sources, this will be far superior to an attempt to modify the Government method of support of research in order to overcome these objections. There will still remain the larger projects that need the Government's attention; it might be better to keep the Government activities in that sphere.

The foundations, of course, have had considerable experience in handling the support of research with a minimum of restriction. The tradition of a foundation is to say: "Once we have made you a grant, you go ahead and spend it as you see fit." This is a tradition which is well worth copying by both the Government and industry for the furtherance of basic research to the degree it deserves.

ROYAL SOCIETY AND NUFFIELD FOUNDATION COMMONWEALTH BURSARIES

APPLICATIONS are invited for awards under the Royal Society and Nuffield Foundation Commonwealth Bursaries Scheme. The bursaries provide travel, maintenance at a rate of about £ 600 a year depending on living costs and the applicant's circumstances and are tenable usually for periods of 2-12 months; they are not intended to provide any salary as such. Bursars will not be permitted to prepare specifically for, or to take examinations for, higher degrees or diplomas.

For proposed visits beginning during the period from January to June 1956, applications must be received complete with supporting documents not later than 15 September 1955, by the Assistant Secretary, The Royal Society, Burlington House, London, W.1., from whom application forms and fuller particulars may be obtained.

NATURE OF INITIATION IN VINYL POLYMERISATIONS

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THE nature of initiation or production of free radicals in thermal as well as catalysed polymerisations, of vinyl monomers is not completely understood. In catalysed polymerizations, the rate of initiation R_i is given by

$$R_i = 2k_d f\,(B) \qquad (1)$$

where k_d is the rate constant for the spontaneous decomposition of the catalyst (B), which is supposed to be independent of the nature of the solvent in which decomposition takes place. f is called 'Catalyst Efficiency' which is defined as the ratio between, the rate of initiation by the primary radicals and the sum of all the rates of reactions by the primary radicals. If k_i and k_a are the specific rate constants for the initiation and first order recombination respectively, of the primary radicals of concentration (R), then according to Matheson[1]:

$$f = [k_i\,(M)\,(R)]/[k_i\,(M)\,(R) + k_a\,(R)] = [k_i\,(M)/k_a]/k_i\,(M) + 1 \qquad (2)$$

(M) is the concentration of the monomer. That f is independent of or dependent on (M), is decided by k_a being negligible or not negligible in comparison with k_i(M). The study of catalysed vinyl-polymerizations in the presence of chain transferring solvent has revealed the nature of f.

The relationship between the degree of polymerisation P_n and concentrations of monomer (M), catalyst (B), and solvent (S) is given by

$$1/P_n = [(k_{tc} + k_{td})^{\frac{1}{2}}(1+X)/k_p(M)]\,(k_d B f)^{\frac{1}{2}} + C_M + C_B(B)/(M) + C_s(S)/(M) \qquad (3)$$

where

$C_M = k_{fm}/k_p$; $C_B = k_{Bf}/k_p$; $C_s = k_{fs}/k_p$; k_{fm}, k_{fB}, k_{fs} are the specific rate constants for chain transfers with monomer, catalyst and solvent respectively. k_p, k_{tc}. k_{td}, are rate constants for propagation, termination by combination and termination by disproportionation respectively and $x = k_{td}/k_{td} + k_{tc}$. Considering that C_M and C_B are negligible and also when $k_i\,(M) \gg k_a$, f is unity and it is seen from (3) that $1/P_n$ linearly varies with $(B^{\frac{1}{2}}/M)$ at constant (S/M). In the polymerisation of styrene in toluene with benzoyl peroxide as catalyst (80° C.), the variation of $1/P_n$ with (S/M) at constant $B^{\frac{1}{2}}/(M)$ and with methyl ethyl ketone peroxide as catalyst (100° C.), the variation of $1/P_n$ with $(B^{\frac{1}{2}})/(M)$ (Fig. 1, A, B, C) as well as $(B/M)^{\frac{1}{2}}$ (Fig. 1, D, E, F), have been studied. From the slopes and intercepts of the parallel linear plots, the following values are obtained. $C = 1{\cdot}43 \times 10^{-5}$ with benzoyl peroxide and

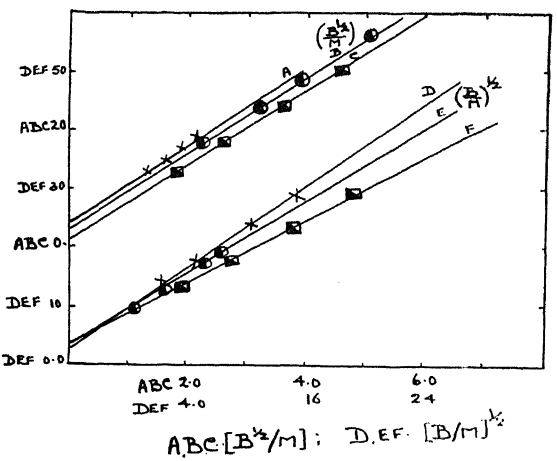


FIG. 1. Graphs A, B, C denote the plots of $1/P_n$ *vs.* $(B^{\frac{1}{2}}/M)$ at constant ratios of (S/M); Graphs D, E, F denote the plots of $1/P_n$ *vs.* $(B/M)^{\frac{1}{2}}$ at constant ratios of (S/M) using methyl ethyl ketone peroxide as catalyst in the polymeristion of styrene.

$5{\cdot}5 \times 10^{-5}$ with methyl ethyl ketone peroxide; the values for $(1 + X)\,(k_{tc} + k_{td})^{\frac{1}{2}}\,(k_d f)^{\frac{1}{2}}/k_p$ are 0·15 with methyl ethyl ketone peroxide, and 0·013 with benzoyl peroxide respectively. The computed value for the latter is 0·014. On the other hand, when $k_a \gg k_i\,(M)$, f will be equal to $1/1 + k_a/k_i(M)$ and $1/P_n$ must regularly vary with (S/M) at constant $(B/M)^{\frac{1}{2}}$ but not at constant $(B^{\frac{1}{2}}/M)$. For the polymerization of vinyl acetate in toluene catalysed by benzoyl peroxide at 75° C., the relationships for $1/P_n$ *vs.* (S/M) at constant $(B/M)^{\frac{1}{2}}$ (Fig. 2, A, B) as well as for $1/P_n$ *vs.* (S/M) at constant $(B^{\frac{1}{2}}/M)$ (Fig. 2, C, D) are given. From the slope (Fig. 2, A, B) the transfer coefficient $C_s = 2{\cdot}7 \times 10^{-3}$ has been obtained.

The third possibility is that k_a and $k_i(M)$ have comparable values when the relationships of $1/P_n$ *vs.* (S/M) at a constant $(B^{\frac{1}{2}}/M)$ as well as $1/P_n$ *vs.* (S/M) at constant $(B/M)^{\frac{1}{2}}$ fail to yield constant slopes from different plots. In such a case both $(B/M)^{\frac{1}{2}}$ as well as $(M)^{\frac{1}{2}}$ should be kept constant. Our study reveals that the catalyst ditertiary butyl peroxide in the polymerisation of styrene in toluene belongs to this class.

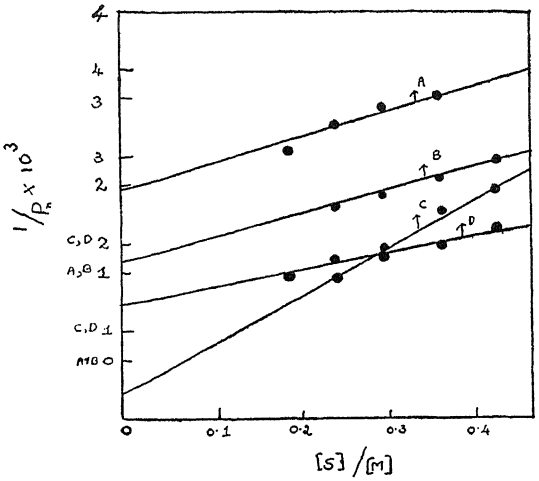


FIG. 2. Graphs A and B are the plots of $1/P_n$ *vs.* (S/M) at constant $(B/M)^{\frac{1}{2}}$; Graphs C and D are the plots of $1/P_n$ *vs.* (S/M) at constant $(B^{\frac{1}{2}}/M)$ using benzoyl peroxide as catalyst in the polymerisation of vinyl acetate.

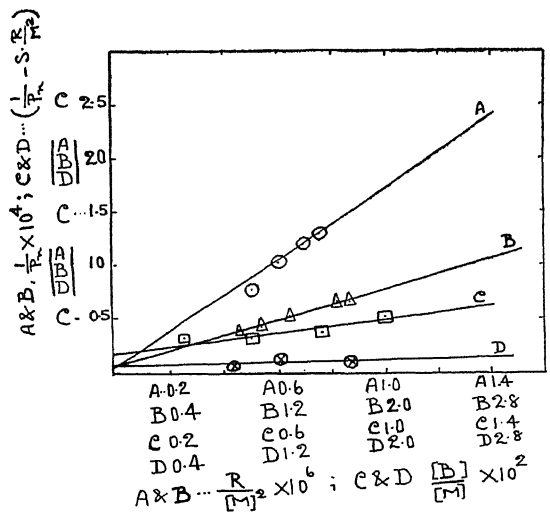


FIG. 3. A and B represent the plots of $1/P_n$ *vs.* R/M^2 using tertiary butyl hydroperoxide (Graph A) and ditertiary butyl peroxide (Graph B) as catalysts in the polymerisation of styrene. C and D represent the plots for the evaluation of C_B.

The rates of initiation in the polymerisation of styrene at 80° C., with the catalysts ditertiary butyl peroxide and tertiary butyl hydroperoxide have also been evaluated. Considering the first term on the right-hand side of the expression (3):

$$(k_{tc}+k_{td})^{\frac{1}{2}}\ (k_d\mathrm{B}f)^{\frac{1}{2}}\ (1+\mathrm{X})/k_p(\mathrm{M}) = (k_{tc}+k_{td})\ (1+\mathrm{X})\mathrm{R}_p/k_p^2(\mathrm{M})^2 \qquad (4)$$

Let the slope of the plot $1/P_n$ *vs.* $R_p/(M)^2$ be A' (Fig. 3, A, B). Since the overall rate in catalysed polymerisation in solution is mainly due to propagation and transfer with the solvent

$$\mathrm{R}_p = -d\mathrm{M}/dt = (k_d f\mathrm{B})^{\frac{1}{2}}(\mathrm{M})\ \{[k_p/(k_{tc}+k_{td})^{\frac{1}{2}}] + [k_{fs}(\mathrm{S})/(k_{tc}+k_{td})^{\frac{1}{2}}(\mathrm{M})]\} \qquad (5)$$

plots of R_p *vs.* $(B^{\frac{1}{2}}/M)$ (Fig. 4, A, B) are linear. Let the slope be K. The rate of initiation is then given by

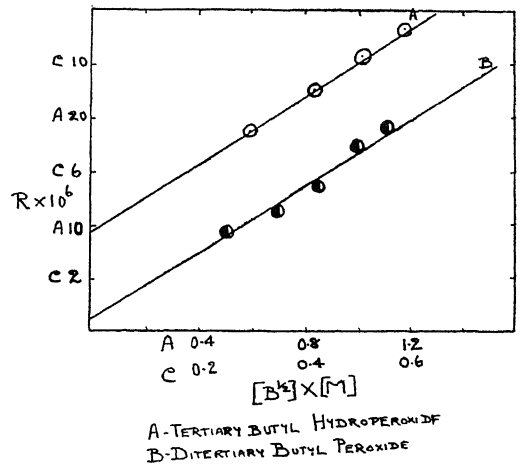


FIG. 4. Graphs A and B represent the plots of rates against Cat. $\frac{1}{2}\times$ M, in the case of styrene using tertiary butyl hydroperoxide (plot A) and ditertiary butyl peroxide (plot B) as catalysts.

$$2\mathrm{K}^2\mathrm{A}' = \mathrm{R}_i(1+\mathrm{X})/(\mathrm{B}) = \mathrm{R}_i'/(\mathrm{B}) \qquad (6)$$

The $R_i'/(B)$ values for ditertiary butyl peroxide and tertiary butyl hydroperoxide catalysed polymerisations of styrene at 80° C. are $2{\cdot}20\times10^{-7}$ and $4{\cdot}25\times10^{-7}$ respectively. The plots C and D in Fig. 3 indicate that the transfer of styrene radicals with these catalysts are very small.

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ON UPWELLING AND FISHERIES

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THE need for new sources of food is not unique in India, but is shared by many other sections of the world. One possible approach in solving this problem is to seek out the sea. It is no longer profitable to sail out blindly in search of new fishing grounds. However, the approach through scientific studies is proving to be of great value in their location. There are some established reasons why fish reproduce and congregate more in one area than another. One reason is food. Fish feed mainly on plankton, smaller fish, etc. These in turn are believed to be dependent upon plant nutrients, which in some regions are controlled by the water circulation. The probability of predicting an area of high fish productivity from the water circulation is here discussed.

The production of organic matter in the sea may come about by several methods. A simple organic cycle is presented in "The Oceans".[1] Inorganic plant nutrients are converted into plants. These plants may then provide food for some animals. All organisms eventually die and are broken down by bacterial action into inorganic plant nutrients. The cycle could then be repeated.

Nitrates, phosphates and silicates are the principal plant nutrients measured in the sea. They are usually found in lower concentrations in the region near the surface, since they are partially used up in these shallower layers by growing plants and, eventually, animals. Although the nutrients are returned to the water when the organisms are decomposed, most of them are dissolved at the deeper depths. Therefore one way of increasing the nutrient concentration in the surface layers is by vertical circulation, which brings the deeper nutrient-laden water towards the surface.

As pointed out in The Oceans,[1] upwelling (and vertical circulation) may occur in the open ocean, as on the Equator, *or along continental coasts* where the prevailing winds are such that upwelling is induced. It has been observed to occur at several places along continental coasts throughout the world. For example, upwelling occurs along the central California coast during the spring. Phelps[2] reports that during this time the silicate at the 60 m. level increased. This should be the season of greatest plankton production which in turn should cause the greatest decrease in nutrients. This increase in silicate can only be attributed to the vertical transport of deeper sub-surface nutrient-laden water.

The best example of the relation between vertical circulation and actual fish catches has recently been described by Cromwell[3] and Sette.[4] Numerous vertical sections of temperature and salinity were taken through the central equatorial Pacific, from which the vertical and horizontal circulation were determined. At the same time and in the same area scientifically controlled catches of tuna were made.

The results "demonstrated that divergence and upwelling at the equator enrich the surface waters with inorganic nutrient salts, stimulating plankton production. Surface waters containing the plankton drift northerly to an adjacent convergence zone. By inference this is believed to maintain a concentration of organisms of the tropic level above the plankton, mainly small fish and squid, which in turn comprise food for yellowfin tuna". The products of upwelling, although they drift somewhat from their origin, cause an unusually rich fishing ground.

Although this study was made in the open sea far away from the mainland there appears no reason why a similar relationship should not exist off the east central coast of India.

From the oceanographic studies[5] conducted by the Andhra University it was established that upwelling and sinking occur at different seasons. This was determined from the vertical temperature sections off the Waltair coast and the seasonal temperature and salinity cycle of nearshore surface water. The upwelling period was found to last at least during the months of March to May. With more data[6] from the northern coastal region it is now believed that the effects of upwelling near the coast still exist in June as well.

The geographical extent of the upwelling zone along the coast, as well as distance from shore, have not been definitely established. An estimate of the boundaries of this zone is shown in Fig. 1. In this figure the east coast area considered is shaded in *A*, enlargements of the surface projections in *B* and *D*, enlargement of a vertical section off Waltair in *C*, and a key to the density units used, in *E*. The more dense, high nutrient water has the heavier shading. Currents, both vertical and horizontal, are shown by arrows. It can be seen that in *C* the

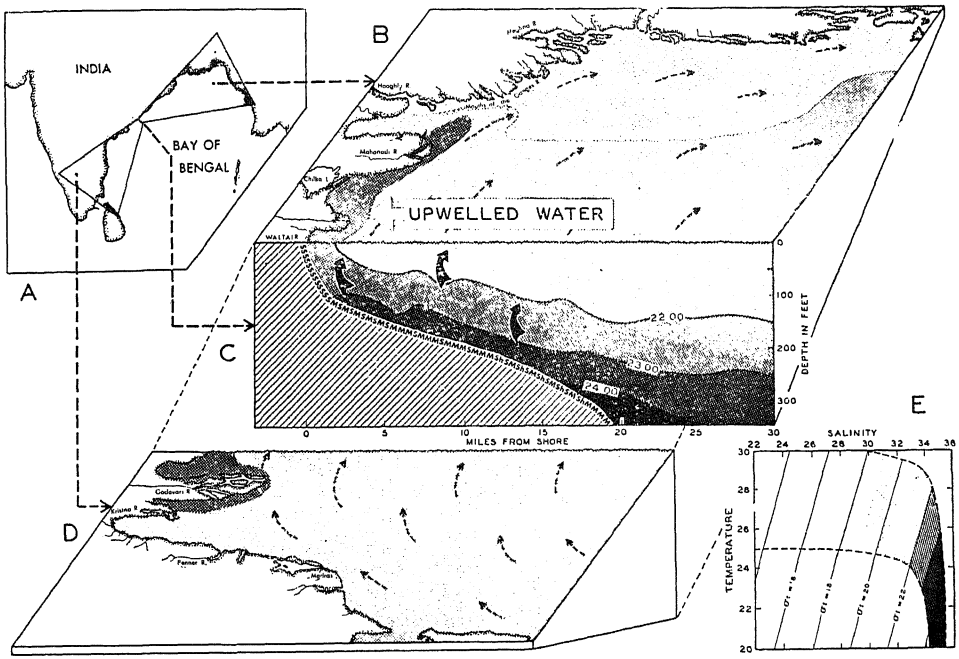


FIG. 1. Distribution of Sea Water Density off the East Coast of India in Spring showing Horizontal and Vertical Circulation and the General Region of Upwelling.

heavier nutrient laden water is brought up to the surface nearshore as the result of the S.W. winds, which move the surface water away from the shore. The upwelled water flows north with the prevailing coastal currents of this season. In June high salinity water was observed off Saugor Island, probably the results of upwelling farther down the coast. The southern limit of upwelling is not known, but probably extends south of the Godavari Delta. It does not appear to extend to the southern coast since at Mandapam the phosphates, silicates, nitrates and salinity do not reach a maximum during the spring season.[7]

Dr. Ganapati and Mr. Murthy[8] of the Andhra University have made extensive studies of the plankton off the Waltair coast. They observed a maximum flowering of diatoms during the upwelling months. This is in accord with previous cited cases of high nutrient concentrations and upwelling observed elsewhere in the world. The actual steps from plankton to larger fish food forms is not thoroughly understood, but there seems to be no reason why this should not take place over the continental shelf off the east central coast. The physical motion, upwelling, occurs there, as do also nutrients and abundant plankton. It logically follows that larger forms comprising fish food and fish themselves should abound in and adjacent to this upwelling zone. In the interest of increased food production, the east central coast should be thoroughly investigated as a commercial fishing ground of economic importance.

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3. Cromwell, *J. Mar. Research*, 1953, **12**, 196.
4. Sette, Oscar, E., *Proceedings of the Eighth Pacific Science Congress*, Quezon City, Philippines, Nov. 1953 (in press).
5. LaFond, E. C., *Andhra University Memoirs in Oceanography*, 1954, **1** (11).
6. ———, E. C., *Ibid.*, **2** (in press).
7. Jayaraman, R., *Ind. J. of Fish.*, 1954, **1**, 345.
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MODIFICATIONS OF CORTISONE

THE application of a technique for corticotrophin therapy in rheumatic conditions by spaced intravenous infusions is described by Beattie and Hartfall in a recent issue of the *British Medical Journal* (1955, June 25, 1499). This report is encouraging since carefully controlled clinical trials designed to study the value of cortisone in the treatment of rheumatoid arthritis have failed to show that it has any advantage over aspirin when two strictly comparable groups of patients are compared, the one receiving cortisone and the other aspirin in large doses.

In the meantime the recognition that apparently minor changes in the structure of the steroid molecule may profoundly modify the clinical and biochemical effects of these substances has stimulated the chemists' imagination and led to the trial of numbers of such variants.

The first successful one was hydrocortisone (Kendall's Compound F), which became available in 1951. Boland estimated that hydrocortisone (free alcohol) was 50% more potent milligram for milligram than cortisone acetate or cortisone (free alcohol), although hydrocortisone acetate was less effective than either, and he suggested that hydrocortisone was less likely to cause side-effects such as sodium retention. However, the advantages of hydrocortisone over cortisone have been almost entirely utilized for intra-articular injections.

The halogenated derivatives of hydrocortison have also come in for some attention sinc animal studies suggested that these have higher glycogenic activity. 9-Alpha-fluoro hydrocortisone has apparently ten times th activity of cortisone in this respect. Unfortu nately the salt—and water-retaining effec was enhanced also, and to apparently a greate extent than its anti-rheumatic action, thu making the substance useless for practica therapy. This steroid was also effective whe given by intra-articular injection, but again s potent was its sodium-retaining property tha this militated against its practical use.

Another variant, hydrocortisone t-butyl-ace tate, was however found by Hollander and hi colleagues to be more effective. Although c no immediate practical consequence, studie such as these point the way to the possibilit of improved clinical results. The variant teste apparently differs from cortisone only in th addition of one double bond and is known a metacortandrecin ("metacorten") or predni sone. It is reported to have, dose for dose five times the initial beneficial effect of corti sone in rheumatoid arthritis and other rheuma tic conditions, while electrolyte studies showe its salt-retaining properties to be slight and it effect on diabetes to be comparable to that c cortisone.

INDIAN RAUWOLFIAS AND THEIR PLACE IN THERAPY

THE root of the plant *Rauwolfia serpentina* has been employed for centuries in Indian medicine for the relief of various central nervous system derangements, both psychic and motor, including anxiety states, excitement, maniacal behaviours associated with psychosis, schizophrenia, and epilepsy. It has recently gained importance because of the promise it holds of being a suitable tool in the modern physician's armamentarium for the treatment of hypertension. Several commercial houses and groups of research workers in university laboratories, both in this country and outside, are at present actively engaged in isolating the most potent fraction or fractions from this plant, which would give satisfactory results without any untoward side-effects sometimes noticed during the administration of the whol crude drug or its powders.

In this connection a critical survey of th present state of knowledge on the chemistry pharmacology and clinical uses of the Rauwolfi has been presented by Dr. B. Mukerji, Direc tor, CDRI, Lucknow, in an article contribute to the *J.S.I.R.* (Supplement to the July 195 issue).

The article covers the following aspects description and distribution; botanical an pharmacognostical aspects of *Rauwolfia serpen tina* and other species; chemical composition alkaloidal content of different species; pharma cology; bioassay of preparations and therapeu tic uses.

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EFFECT OF HEAT TREATMENT ON THE COERCIVE FORCE OF FERRUGINOUS MANGANESE ORES

In a recent paper[1] some of the results obtained on the magnetic properties of the ferruginous manganese ores of the Visakhapatnam District have been published. These have been obtained at the laboratory temperature using the oscillographic technique. In the present investigation the effect of heat treatment on the magnetic properties of a certain ferruginous manganese ore sample collected at Garividi, in Visakhapatnam District, has been studied.

The above ore sample was powdered and analysed for the total iron and manganese percentages. The sample (41·2% Mn, 18% Fe) corresponding to $-150+200$ mesh was made into several fractions and each fraction was heated to a certain temperature in air in an open furnace for about 15 minutes. In all five fractions were made, the temperature ranging from 300-900° C. The magnetic properties of these fractions were studied by the oscillographic technique of Bruckshaw and Rao.[2] Two sets of I and H curves were drawn at a peak-field of 700 and 800 oersteds. From these curves, the values of the coercive force were read. The results are given in Table I.

For both the peak-fields of 700 and 800 oersteds, the results show that the coercive force is a maximum for the fraction heated

TABLE I

Temperature °C.	Coercive force in oersteds	
	(*a*)	(*b*)
310	96	151·2
370	140	158·2
620	152	180·0
720	88	144·0
870	120	129·6

(*a*) Peak-field 700 oersteds (*b*) Peak-field 800 oersteds

to 620° C. From the room temperature, the coercive force shows a marked increase and reaches its maximum at 620° C. and then falls off at higher temperatures. This rise in coercive force can be explained by the following dispersion theory.[3]

In any magnetic material we may postulate the existence of elementary magnets or magnetons. Magnetic materials including minerals are generally metallic; that is, they are conductors of electricity and their structure may be represented by positive nuclei in a field with at least some free electrons. Certain of these positive nuclei will act as centres for the magnetons. In an ideal magnetic substance the magnetons can be considered to be spheres with uniform charge distribution, capable of moving in negative electron field without resistance. By formation of a phase below its temperature of crystal growth and by formation of a disperse system of two phases, at least one of which is magnetic, the positive nuclei of the magnetic material are displaced from their equilibrium positions, with the result that the field is distorted and the groups of positive nuclei, called pseudomolecules, become bound together by electrons. Now it is obvious that the magnetons would be bound by such a process and a more intense field would be required to produce alignment of the magnetons. And once aligned an increased field corresponding to high coercive force would be required to break down this line-up.

The formation of disperse systems can be accomplished by the method of heating to form a solid solution, quenching to retain the solution and then re-heating to form a dispersion from the solid solution. In some instances the treatment may be simple heating to a certain temperature as in the case of manganese ores. The general principle of treatment is to render the iron content of the mineral in such a form that it may be converted to a magnetic state, usually Fe_aS_b, by reduction or oxidation at a temperature that does not permit crystal growth.

It is found by the present investigation that a higher coercive force could be established for this manganese ore sample at a temperature round about 600° C.

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Dept. of Geophysics,
Andhra University,
Waltair, *December* 20, 1954.

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FORCE CONSTANTS OF BCl_3 MOLECULE

IN continuation of the previous calculations of the force constants for BF_3 molecule by the author,[1] similar calculations are carried out for BCl_3. The molecule belongs to the point group D_{3h}, assuming a plane symmetrical model. The six normal modes are classified as $A_1' + A_1'' + 2E'$, following the notation of Herzberg.[3] Out of the three modes, A_1' represents the motion of the atoms in a plane perpendicular to the plane of the molecule and in the present calculations types A_1' and E' alone are considered in order to evaluate the in-plane valence force constants. A_1' mode is Raman active and infrared inactive. E' mode is active in both. The force constants are determined using 471 cm.$^{-1}$ of A_1' mode and 956 cm.$^{-1}$ and 243 cm.$^{-1}$ of E' mode fundamentals of $B^{11}Cl_3$ given by Scruby Lacher and Park.[2] The constants thus obtained are used to determine the corresponding frequencies of the isotopic molecule $B^{10}Cl_3$, which are compared with those given by Scruby and others.

The potential energy expression is given by

$$2V = f_d(\Delta d_1^2 + \Delta d_2^2 + \Delta d_3^2) + d^2 f_a(\Delta\alpha_1^2 + \Delta\alpha_2^2 + \Delta\alpha_3^2) + 2f_{dd}(\Delta d_1\Delta d_2 + \Delta d_1\Delta d_3 + \Delta d_2\Delta d_3) + 2df_{ad}[(\Delta\alpha_1 + \Delta\alpha_3)\Delta d_1 + (\Delta\alpha_1 + \Delta\alpha_2)\Delta d_2 + (\Delta\alpha_2 + \Delta\alpha_3)\Delta d_3] + 2df'_{ad}(\Delta\alpha_2\Delta d_1 + \Delta\alpha_3\Delta d_2 + \Delta\alpha_1\Delta d_3) 2d^2 f_{aa}(\Delta\alpha_1\Delta\alpha_2 + \Delta\alpha_2\Delta\alpha_3 + \Delta\alpha_1\Delta\alpha_3)$$

where d is the B-Cl distance, and f'_{ad} is the interaction force constant between the B-Cl stretching and the bending of the angle formed between two other B-Cl bonds. This force constant is neglected in the calculations of BF_3 assuming that it would be generally very small

in comparison with the other constants. With the introduction of $f'_{\alpha\alpha}$ the P.E. expressed is considered to be a more general one. The significance of the remaining symbols in the above expression is the same as given in reference.[1] The elements of the P.E. matrix and of the K.E. matrix are obtained with the help of the above expressions and adopting the method described in detail elsewhere.[1] The value of f_{dd} was determined using 471 cm.$^{-1}$ of A_1' type substituting the value of f_d obtained by Badger's[4] rule. Using 955 cm.$^{-1}$ and 243 cm.$^{-1}$ of E' type, two combinations of four force constants, namely $(f_{\alpha d} - f'_{\alpha d})$ and $(f_\alpha - f_{\alpha\alpha})$ could be evaluated. Two sets of force constants are obtained while solving the secular equation for E' mode because of the quadratic nature of the equation. These are given in Table I. They are used in arriving at the corresponding frequencies of the isotopic molecule $B^{10}Cl_3$. Table II summarises the data.

TABLE I

Force constants ($f \times 10^{-5}$ *dynes/cm.*)

	Set I	Set II
f_d ..	3·227 (Badger's rule)	3·227
f_{dd} ..	0·706	0·706
$f_{\alpha d} - f'_{\alpha d}$..	−0·69	3·103
$f_\alpha - f_{\alpha\alpha}$..	0·158	1·065

TABLE II

Type of vibration frequencies in cm.$^{-1}$

	$B^{11}Cl_3$ (Scruby)	$B^{10}Cl_3$ (Scruby)	$B^{10}Cl_3$ (Author) calc.
A_1' ..	(471)	471	471
E' ..	(955)	995	994
	(243)	244*	261

The frequencies in the parenthesis are those used in the present calculations. The frequency with the star is obtained by the product rule by Scruby and others. The first set of the constants gives rise to the frequencies of the isotopic molecule $B^{10}Cl_3$ which are in good agreement with those given by Scruby and others while the second set gives wide divergences; it may therefore be ignored.

The author is highly indebted to Dr. K. R. Rao for his kind guidance during this work and to the Government of India for awarding a Senior Research Scholarship.

Dept. of Physics, V. SANTHAMMA.
Andhra University,
Waltair, *March* 3, 1955.

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THE SHRINKING HORIZON IN THE STEADY-STATE THEORY OF THE EXPANDING UNIVERSE

IN 1948 Bondi and Gold[1] put forward the steady-state theory of the expanding universe. In the same year appeared an interesting paper by Hoyle[2] modifying the field equations of general relativity so as to incorporate the idea of a continuous creation of matter as suggested by Bondi and Gold. In ths steady-state theory of the universe every fundamental observer has got a separate well-defined horizon. Recently, Whitrow[3] has discussed a situation involving two fundamental observers A and B and a galaxy C on the horizon of A, on AB produced. He raises the question that since C is not on the horizon of B, it may be possible for C to establish contact with A through an intermediary like B. Pirani[4] has shown why this programme cannot be carried out. Gold's[5] letter, however, raises further questions in this matter.

In fact there are two types of the horizon: the one being the effective theoretical horizon H_T and the other the effective observable horizon H_0. The range of H_0 may be widened to a certain extent by using better instruments of observation. H_T is a function of time and what we wish specially to point out is that it is a shrinking horizon. Once it is realized that the theoretical horizon of an observer is a shrinking one, several controversial questions appear to be well explained.

The space-time of the steady-state universe is given by de Sitter's line-element

$$ds^2 = dt^2 - e^{2kt}(dx^2 + dy^2 + dz^2) \qquad (1)$$

with

$$r = \sqrt{(x^2 + y^2 + z^2)},$$

k being Hubble's constant and the velocity of light being taken as unity. A pulse of light starting from $r = 0$, where the observer is located at time $t = t_0$ reaches a distance r at time t:

$$-\frac{1}{k}(e^{-kt}-e^{-kt_0})=r \qquad (2)$$

The horizon at $t=t_0$ is obtained by proceeding to the limit $t=\infty$ and is found to be $k^{-1}e^{-kt_0}$. Thus the horizon when $t_0=-\infty$ is infinite. At $t_0=0$ the radius is k^{-1} while at $t_0=\infty$, it is zero. The radius of the horizon thus shrinks from ∞ to 0. The question arises now if communication can be established between two observers which may or may not be within a distance of $k^{-1}e^{-1kt_0}$ of each other at $t=t_0$.

Let us suppose that C is on the horizon of A at time $t=0$ at a distance c. It then transmits light to B at a distance b from A which reaches B at t_1. Then

$$-k^{-1}(e^{-kt_1}-1)=(c-b) \qquad (3)$$

But $c=k^{-1}$ and hence $e^{-kt_1}=\frac{b}{c}$.

At this time t_1 the effective horizon has the radius

$$k^{-1}e^{-kt_1}=b.$$

Hence when light reaches B, B is on the effective horizon of A and since A, B, C are stationary relatively, it follows that the horizon has shrunk from the value k^{-1} to b during the time-interval of the phenomenon. When the light from C reaches A the horizon shrinks to one of zero radius. No communication originating at $t=t_1$ from beyond the theoretical horizon $k^{-1}e^{-kt_1}$ can reach an observer within a finite interval of time.

The features of the steady-state theory which have a bearing on the phenomenon of the shrinking horizon deserve to be reviewed carefully.

I should like to express my thanks to Professor V. V. Narlikar for his guidance in preparing this communication.

Dept. of Physics, SACHCHIDANANDA GUPTA.
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April 18, 1955.

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ON ESTIMATION OF MASS

THERE have been several studies both in U.K. and U.S.A. about the accuracy of visual estimation of distance, which have been summarised by Whitney and Higgins.[1] Sodha and Mehta[2] have made a study of mental estimation of time. This note presents a study of estimation of mass by 26 members of staff of Defence Science Laboratory, New Delhi.

The subjects were requested to estimate the mass of six books, four metallic objects and three other miscellaneous objects, in a random order as given in Table I. No time limit for giving the estimation was imposed and the subjects were allowed to handle the objects. The subjects were free to give their estimation in any unit of mass.

The mean estimated mass $\bar{E}$ and the mean deviation $(E\sim\bar{E})$ in grams for all the objects are given in Table I. The coefficient of correlation between the mean deviation and the mean estimated mass for all the objects taken together was found to be very high ($r=0{\cdot}97$ for eleven degrees of freedom), the regression equation being

$$\overline{(E\sim\bar{E})}=0{\cdot}3728\,\bar{E}+7 \qquad (1)$$

The values of mean deviation, calculated from the above relation have also been tabulated for comparison in Table I.

The correlation between the mean estimated mass $\bar{E}$ and the mass M of the six books was also very high ($r=0{\cdot}987$ for four degrees of freedom), the regression equations being:

$$\bar{E}_{book}=0{\cdot}9441\,M-121 \qquad (2\,A)$$

The correlation between E and M for the four metallic objects was also very high ($r=0{\cdot}9996$ for two degrees of freedom). The appropriate regression equation is:

$$\bar{E}_{metal}=1.2330\,M-1 \qquad (2\,B)$$

TABLE I

Estimation of mass in grams by 26 D.S.L. subjects

No.	Object	Order	Mass M	Mean estimated Mass $\bar{E}$		Mean Deviation $(E\sim\bar{E})$	
				Observed	Calculated	Observed	Calculated
1	Glass plate	VI	30	42		28	23
2	Iron bar	XII	60	71	73	29	33
3	Screw driver	IV	113	128	138	43	54
4	Marble	VII	155	144		60	61
5	Pulley	III	186	233	228	83	94
6	Paper weight	X	230	146		70	61
7	Book	XIII	340	212	200	87	86
8	Book	II	420	270	276	97	108
9	Wrinch	VIII	590	740	726	312	283
10	Book	IX	720	603	559	246	232
11	Book	I	804	577	638	201	222
12	Book	V	902	701	731	326	267
13	Book	XI	1033	897	854	281	341

The values of $\bar{E}$ as calculated from equation (2A) and (2B) for books and metallic objects have also been listed in Table I for comparison.

The results have been illustrated graphically in Figs. 1 and 2.

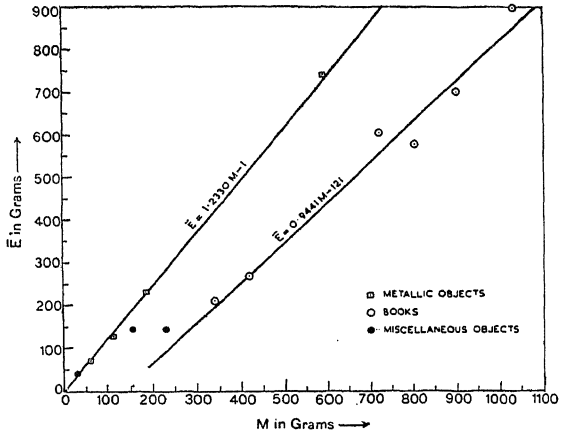


FIG. 1. Regression of mean estimated mass $\bar{E}$ on the true mass M.

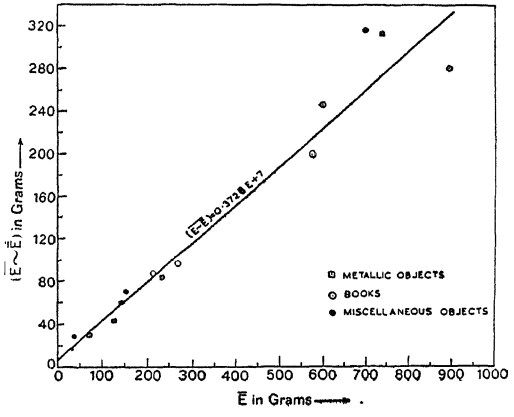


FIG. 2. Regression of mean deviation $\overline{E \sim \bar{E}}$ on the mean estimated mass $\bar{E}$.

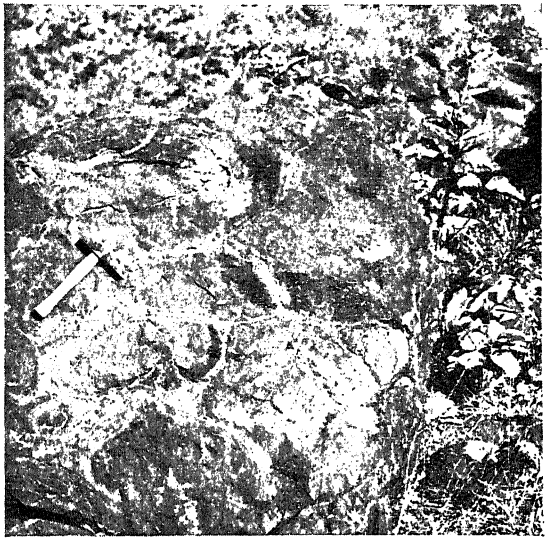
The authors are grateful to Dr. D. S. Kothari, Dr. R. S. Varma and the subjects for their kind interest in the investigation.

Defence Science Lab., M. S. SODHA.
New Delhi-12, V. B. TAWAKLEY.
May 14, 1955. V. K. JAIN.

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OCCURRENCE OF PILLOW LAVAS IN THE KOLAR SCHIST BELT

SPILITIC rocks of Dharwar age showing pillow structure have been recorded by Pichamuthu[1] from many localities in the Chitaldrug District, and by Ramamurthy[2] in the Bellara traps in the Tumkur District in Mysore State. In the Kolar Schist belt, the Mysore geologists[3] have described metamorphosed basic volcanic rocks, uralite basalt, uralite diabase, hornblende granulite, tufted green amphibolite, amygdular basalt, etc., which have been widely altered to hornblende schists. Recent structural mapping of the Kolar Gold Fields by the Geological Survey of India has brought to light occurrences of pillow structure in exposures of uralite basalt at many places. A typical exposure of the pillow lava (Fig. 1) showing clearly undistorted pillows may be seen on the western slope of the ridge along the Kamasamudram Road, 2 miles south of Marikuppam Railway Station. The pillows are exposed over an area



—Photo by A. V. Ramachandra.

of 150′ × 75′ in the uralite basalts. They are either globular, spheroidal or ellipsoidal, but usually irregular and contorted. They vary in size from about 6″ to 2′ in diameter, sometimes attaining more than 3′. The boundaries of the pillows are marked by a thin skin up to an inch in thickness. At a few places, where the exposures are undisturbed, the tops of the flows and the stratigraphy of the associated group of steep-dipping rocks may be established with the help of the pillows in the uralite basalts. This may be confirmed by other evidences, as for example, cleavage-bedding relations in the

associated horizon of schistose tufted amphibolite, which occurs everywhere in regular stratigraphic order with the massive and granular uralite basalt.

The pillow-bearing lavas, which have been previously described as uralite basalts, are really fine-grained metabasalts of spilitic composition. Thin sections of the rock show a fine-grained, variolitic or intergranular texture, with laths of plagioclase of the composition oligoclase-andesine (about 30%), granular, sheaf-like and spherulitic aggregates of blue-green hornblende (hastingsite?) (about 50%) and minor amounts of epidote (about 3-4%), quartz (about 2-3%) and titaniferous iron-ore (about 6-8%).

Detailed petrological study of the Kolar suite of rocks is being carried out to establish the exact composition and metamorphic changes, and their bearing on the original nature of the flows.

S. NARAYANASWAMI.
Geological Survey of India,
Calcutta, *May* 7, 1955.

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CORDIERITES FROM BIDALOTI, KORATAGERE TALUK

CORDIERITE-HYPERSTHENE-ANTHOPHYLLITE granulites occurring near the village of Bidaloti, in Koratagere taluk, were described as "Bidaloti series" by Rama Rao.[1] The outcrops occur 60° west of south of Holavanahalli and due south of Bidaloti temple, on the southern flanks of Δ 2580. Many of these cordierite-bearing rocks exhibit faint laminations and banding. They also show honey-combed weathering and ribbed appearance. During the course of the recent investigation of this suite of rocks, cordierite was studied in great detail.

The cordierite occurs as individual grains of variable dimensions measuring 0·4 mm. × 1 cm. in diameter. Here and there, they are found altering to anthophyllite. All the grains of cordierite are flooded with inclusions of iron ores. Some of them contain pleochroic haloes measuring 0·002 mm. × 0·004 mm. in diameter. The optical characters of the cordierites are: refractive indices as studied by immersion method are: $\alpha = 1{\cdot}550$, $\beta = 1{\cdot}545$, $\gamma = 1{\cdot}542$. Birefringence = 0·008 (calculated from indices). Optic axial angle = − 76° (by direct measurement on universal stage).

Usually, the cordierites are commonly twinned on (100) or (130) giving rise to multiple twins. They have been reported from Moghok and Madura in India by Dunn[2] and Krishnan.[3] The cordierites of Bidaloti exhibit multiple and simple twinning (Fig. 1).

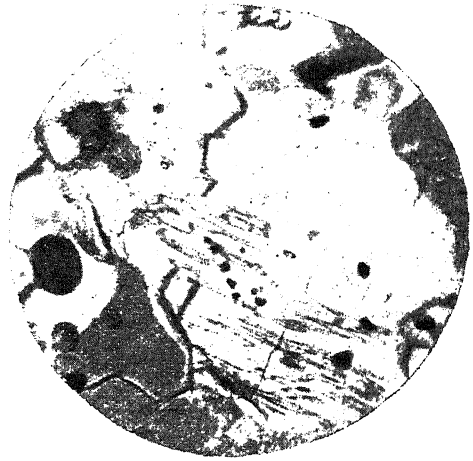


FIG. 1

Some of the grains exhibit incipient sector twinning giving trillings. Venkatesh[4] has described stellate twinning in cordierites from Bokaro coalfields. Recently, stellate twins in cordierites have been reported from the burnt rocks of Jharia and Raniganj coalfields by Naidu.[5]

The multiple twinning in cordierite was determined on the Universal stage in the following manner. The method on the stage is after Reinhard.

The co-ordinates of the axes of the optical indicatrix (X, Y, Z) and the twin pole were plotted on the Wulff's net. Then with the known orientation of cordierite, *i.e.*, $X = c$, $Y = a$, $Z = b$, the three poles X, Y, Z, were transferred on the projection. When the twin pole is trans-

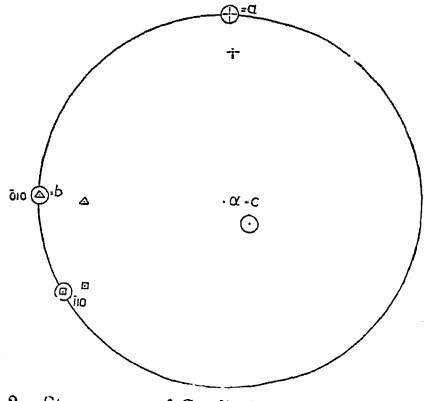


FIG. 2. Stereogram of Cordierite showing twinning

ferred in the same way, we find that it falls between Y and Z, the angle beween the twin pole and Z being 30°, which according to Dana[6] is the angle between (010) and (110) (Fig. 2).

The absence of complex pattern of twinning, and the predominance of simple and lamellar twins in the cordierites of Bidaloti, points to the low temperature conditions prevailing during their formation. Venkatesh[7] has made an extensive study of cordierites from India and has established the relation of the twin laws to temperature. Recently it has been further supported by Naidu.[5]

We wish to acknowledge the valuable guidance and suggestions given by Dr. P. R. J. Naidu throughout the work.

Central College, S. K. Babu.
Bangalore, M. G. Chakrapani Naidu.
June 1, 1955.

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POSSIBILITY OF PREPARATION OF HIGH SPECIFIC ACTIVITY Co^{60} SOURCE FOR RADIOTHERAPEUTIC USE

During the course of work on the Szilard-Chalmer reactions with cobaltic complexes it was found that (*a*) dicyclopentadienyl cobalt (III) nitrate, (*b*) bis-indenyl cobalt (III) nitrate, and (*c*) cobalt phthalocyanine gave high yields of "separable-activity".

Samples of these complexes were irradiated with slow neutrons in the Bepo at Harwell, England. The "separable-activity" was isolated by dissolving samples of (*a*) and (*b*) in water, with cobalt sulfate as carrier, followed by either (*i*) precipitation of cobalt anthranilate, or (*ii*) extraction of cobalt oxinate with chloroform. The method used for (*c*) has been described earlier.[1] Measurements of radioactivity were made with a "well-type" scintillation crystal set-up. The average "separable-activity" was found to be 94%, 97·5% and 95·5% for *a*, *b* and *c* respectively.

Trisacetylacetone cobalt (III) and sodium-ethylenediamine tetra-acetate cobalt (III) under similar conditions yielded 83% and 72% "separable-activity".

Because of the high yield of the separable-activity, the complexes (*a*), (*b*) and (*c*) appear to be suitable for the preparation of "high specific activity" cobalt-60 sources for radiotherapy.

For teletherapy, the higher specific activity would permit the use of smaller size sources having shorter penumbras, which would localize the tissue-damage; and at the same time allow more intense dosage due to reduced self-absorption in the sources.

Chemistry Division, Amar Nath.
Dept. of Atomic Energy, Jagdish Shankar.
Bombay, *June* 24, 1955.

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APPARENT SPECIFIC VOLUME OF CELLULOSE NITRATE IN BUTYL ACETATE

Partial specific volumes of polymers in suitable solvents are required for the determination of molecular weights by the method of ultracentrifuge. Frequently, apparent specific volumes can serve the purpose of partial specific volumes. Density data, from which these are calculated, are also useful in interconverting volume and weight concentrations.

The cellulose nitrate was prepared in the following way. Absorbent cotton was washed well, dried and ground in a Wiley Mill. 7 g. of this were nitrated with a mixture of concentrated sulphuric acid (170 ml.) and fuming nitric acid (70 ml.) for one hour at about 26° C. The acid was then removed by suction, cellulose nitrate thoroughly washed and stabilized by boiling with distilled water. It was dried under vacuum before use. The butyl acetate was of E Merck quality. It was used without further purification.

The nitrogen in a sample of cellulose nitrate was estimated by dissolving it in concentrated H_2SO_4 and titrating against a solution of ferrous ammonium sulphate according to the method of Mitra and Srinivasan.[1] The nitrogen content was 13·2%. The D.P. of the material was calculated from viscosity using the equation of Alexander and Mitchell.[2] It was of the order of 500.

The densities were determined at 30° ± 0·1° C. Ordinary specific gravity bottles were used for higher concentrations and Sprengel type pyknometer for lower concentrations. These had a volume of about 42 ml., so that weighing to ± 0·5 mg. was considered sufficiently accurate. Tares of same size were used to compensate

for the buoyancy effect, no correction being applied for the weights.

The results are presented in the following table:

Wt. per cent. of cellulose nitrate	Density in g./ml. at 30° C.	Apparent specific volume
0	$0{\cdot}8597_0$	..
1·39	$0{\cdot}8650_2$	$0{\cdot}64_4$
1·08	$0{\cdot}8640_0$	$0{\cdot}63_5$
0·799	$0{\cdot}8628_4$	$0{\cdot}64_1$
0·548	$0{\cdot}8619_2$	$0{\cdot}61_9$
0·314	$0\ 8609_6$	$0{\cdot}62_4$
0·194	$0{\cdot}8605_0$	$0{\cdot}63_4$
	Mean	$0{\cdot}63_3$

The apparent specific volume of cellulose nitrate in butyl acetate is thus found to be 0·63.

ATIRA, A. G. CHITALE.
Ahmedabad-9, *May* 6, 1955.

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THE P BLOOD GROUP IN INDIANS

ACCORDING to Race and Sanger[2] strong examples of human anti-P sera are rare. It is therefore considered worthwhile to record the presence of an anti-P antibody active at 37° C. in the serum of a male blood donor of group A_1B. The antibody appeared to be of spontaneous origin since the donor gave no history of transfusion or injection of blood. On preliminary examination the antibody agglutinated 14 out of 26 bloods, and with one exception seemed to have the specificity anti-P. Because of an element of doubt introduced by the exception the serum was forwarded to the Blood Group Reference Laboratory, London, where Miss Dorothy Parkin kindly identified the antibody as anti-P. (The single exception, thought to be P — ve, was subsequently found to be a weak P + ve.)

No extensive survey of the P blood group in Asians has yet been undertaken.[1] The serum was therefore used to determine the P groups of 526 random Indians (blood donors and laboratory staff) of no definite ethnological status. The serum was absorbed in the cold with P — ve cells to remove 'non-specific' cold agglutinins and simple tube tests as described by Race and Sanger[2] were carried out both in the cold (4° C.) and at laboratory temperature (28° C.) with completely concordant results. Weak P + ve and P — ve cells were used as controls. The results were read as either P + ve or P — ve, that is the various grades of P + ves were not taken into account. The following results were obtained.

Positive—304 (57·8%).
Negative—222 (42·2%).
Total—526 (100·0%).

The gene frequencies calculated from the above are as under:

P—0·35035.
p—0·64965.

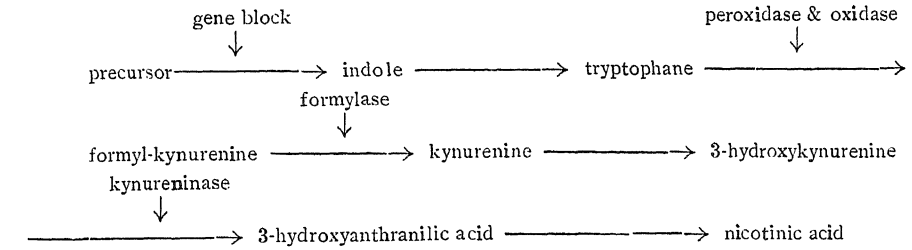
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INFLUENCE OF B-VITAMINS ON THE INHIBITION BY CASEIN HYDROLYSATE OF TRYPTOPHANE UTILISATION IN *NEUROSPORA CRASSA*

INTENSIVE studies have been carried out on the biological conversion of tryptophane to nicotinic acid and the enzymes involved in the conversion have been identified.[1] Of the various factors which are involved in the conversion, the influence of the level of dietary protein is one.[2] In the earlier work, the adverse effect produced by the proteins have been attributed to the influence of the amino acids of the proteins on the digestive tract,[3] whereas later work has suggested their influence on certain enzyme systems in the conversion.[4] Evidences in favour of the latter view have been provided by the work of Shanmuga Sundaram and Sarma on the influence of protein hydrolysates[5] and amino acids[6] on the utilisation of tryptophane by a nicotinic acid requiring mutant of *Neurospora crassa* (strain 39401). They have found that the protein hydrolysates and certain amino acids inhibit the utilisation of tryptophane by *N. crassa*. Confirmatory results of the above observation have come out from the work of Jakoby and Bonner[7] who have isolated the enzyme 'kynureninase' from *N. crassa* and demonstrated the deleterious effect of certain amino acids in the enzyme system. In the present note the effect of B vitamins when present alone and along with casein hydrolysate on the utilisation of tryptophane by *Neurospora crassa* is reported.

The strain of *Neurospora crassa* used here is able to utilise all the metabolites of tryptophane for nicotinic acid synthesis and the gene



is located at the precursor indole linkage as illustrated in the accompanying scheme:

The organism was cultured in Fries' medium as described by Horowitz and Beadle[8] and was allowed to grow in 50 ml. conical flasks, the total volume of the media being 10 ml. (5 ml. of double concentration *plus* 5 ml. of water) containing the following substances in the basal medium in mg., ammonium tartarate-50; ammonium nitrate 10; potassium phosphate (mono basic)—10; magnesium sulphate—5; sodium chloride and calcium chloride—1·0 (each); dextrose—200; and the following trace elements in micrograms: B—0·1; Mo—0·2; Fe—2·0; Zn—20; Cu—1·0; Mn—0·2 and the vitamin biotin 0·5 milli-microgram. The pH of the medium was 5·6. After 72 hours' growth at 30° C., the mycelia were carefully removed, washed, dried at 60° C. to constant weight and finally the dried mycelia were weighed in a Roller Smith Torsion balance.

TABLE I

Influence of B vitamins alone and in presence of casein hydrolysate of tryptophane utilisation by Neurospora crassa (39401)

No.	Substances added to the basal medium*	Wt. of mycelia in mg.		
		Without casein Hydrolysate	With casein hydrolysate (containing 1·5 mg. N)	
			HCl hydrolysed	H_2SO_4 hydrolysed
1	No supplement (control)	24·1	12·8	14·0
2	1 mg. thiamine	23·2	24·1	25·7
3	1 mg. riboflavin	14·2	6·4	8·1
4	1 mg. pyridoxine	23·0	27·5	26·2
5	1 mg. *p*-aminobenzoic acid	25·2	16·5	15·1
6	1 mg. folic acid	25·0	23·6	27·1
7	1 mg. calcium pantothenate	25·2	12·0	14·4
8	2 mg. choline	25·4	25·5	26·0
9	1 mg. inositol	25·0	11·3	13·8
10	2 μg. vitamin B_{12}	24·6	16·0	14·6

* Basal medium contains 250 microgram L-tryptophane in 5 c.c. double concentration medium.

The results of the influence of each B vitamin alone and in combination with casein hydrolysate on the utilisation of tryptophane by *Neurospora crassa* are presented in Table I.

From the table, it can be seen that all B vitamins excepting riboflavine do not exert any influence on the utilisation of tryptophane when present in the medium. However, riboflavine seems to lower the utilisation. Also, from the results it is observed for the first time that the inhibition produced by the casein hydrolysate or otherwise by certain amino acids present in it on the utilisaton of tryptophane is overcome by thiamine, pyridoxine, folic acid and choline, whereas riboflavine seems to inhibit the utilisation still further. Further work with other tryptophane metabolites, casein dephosphorised enzymatically and by alkaline treatment, and certain pure amino acids are in progress and will be published in detail elsewhere.

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AMINO-ACID COMPOSITION OF THE PROTEINS OF PUMPKIN

As a source of proteins pumpkin (*Cucarbita maxima*, Duchesne) is poor,[1] yet a study of the proteins of this fruit vegetable was made in view of its extensive use in a predominantly cereal diet. The fruit as obtained from the local market was separated from the seeds, shredded and sun-dried for 7-8 hours till dry. The dry material was then milled to 80 mesh fineness. Pigments were removed by extracting the powder with acetone in a soxhlet apparatus till the powder had a very light yellow colour. One kg. of the wet material gave roughly 85-90 g. of the powder on a pigment-free basis.

The extraction of the total proteins was carried out using 0·5% sodium hydroxide (1 litre for 100 g. powder), and the proteins precipitated with 10% acetic acid. The precipitated proteins were washed free of acetate ions and dehydrated with acetone to give a fine yellow powder. One hundred g. of the dry powder gave 22-23 g. of crude protein 45-50% pure according to the nitrogen values.

The protein preparations so obtained were analysed for nitrogen, moisture, ash percentages and for amino acids by microbiological methods, after purification.

The purified proteins of pumpkin contained 13·2% nitrogen, 1·82% ash and 0·3% moisture. Of the total nitrogen 6·3% was amide nitrogen, 2·3% humin nitrogen, 37·1% basic nitrogen and 53·2% was non-basic nitrogen.

The amino acid content is given in Table I and compared with that of casein analysed under identical conditions.

TABLE I

Amino acid content of pumpkin protein and casein

Amino acid	Test organism used	Pumpkin protein	Casein	Reference to method
1 Arginine	*S. fæcalis*	14·1	4·0	(4)
2 Threonine	do	2·7	4·1	(4)
3 Cystine	*L. mesentroides* P. 60	2·0	0·4	(3)
4 Methionine	do	2·8	3·7	(3)
5 Histidine	do	4·2	2·6	(3)
6 Lysine	do	4·2	6·8	(3)
7 Phenylalanine	do	6·2	5·3	(3)
8 Tyrosine	do	4·6	6·3	(3)
9 Isoleucine	*L. arabinosus* 17/5	5·8	6·4	(2)
10 Leucine	do	8·6	11·3	(2)
11 Tryptophane	do	2·1	2·1	(2)
12 Valine	do	6·6	7·5	(2)

In paper chromatographic studies the protein of pumpkin showed the same amino acid pattern as casein. It, therefore, appears that it is as complete a protein as casein. Pumpkin protein has 3·5 times as much arginine and 5·0 times as much cystine as casein. It also has a higher histidine and phenyl-alanine content, but lysine appears to be the limiting amino acid of the protein.

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A NEW SPECIES OF MARINE CHITIN DIGESTING BACTERIUM*

THE very prodigious production of chitinous organisms in the sea would tend to lock up a vast store of nitrogen which would be unavailable unless released in an assimilable form. However, bacteria are known to break down chitin in marine environment.[1] Johnson isolated some chitinovorous bacteria from crabs. Benton[1] and ZoBell and Rittenberg described a number of marine chitin digesting bacteria from marine environment without naming them. We detected the presence of chitin digesters in sea-water, marine sand, and in chanks by enrichment technique of Hock. Four cultures were found to utilize chitin as sole source of carbon and nitrogen.

Description of the chitinoclastic bacteria rods, gram negative, coccoid, 0·6-0·8 × 0·8-1·0 mostly single, a few in pairs or chains, actively motile with a single polar flagellum about six times the length of the cells; non-spore-forming. Colonies, gray translucent, effuse, flat, fimbriate margin; stroke cultures: abundant, smooth, gray, echinulate, turning cream yellow with ageing. In sea-water broth, white membranous fragile pellicle, and high turbidity; no growth in fresh-water broth and on potato. Acid from glucose, sucrose, galactose, mannitol and glycerol, but arabinose, xylose and lactose not fermented; starch hydrolysed; H_2S produced by 3 out of 4 cultures (peptone iron agar). Nitrates reduced to nitrites, gelatin rapidly liquefied, indole not produced from tryptone. Brom-cresol-purple milk unchanged, but with

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% NaCl in it, was coagulated becoming alkaline. Grows in media containing 10% NaCl†; mmonia produced from peptone, asparagine nd chitin, but not from urea; aerobic faculative. No growth on fresh-water media.

Source.—Four cultures from the Indian sacred hank (entire flesh) (*Xancus pyrum*). *Habitat.*—Sea-water, marine bottom.

Since the description does not agree with any escribed in literature, this is considered as ew species—*Pseudomonas chitinovora* N. sp.

A mineral salt solution having the composion (W/V) K_2HPO_4 0·1%, $MgSO_4$ 0·02%, aCl_2 0·01%, $FeCl_3$ 0·002% made up with 'aged' ea-water was used. When purified chitin prepared according to Benton[2]) alone was dded, visible growth of the cultures was oticed in 24-48 hours and the chitin was comletely digested in 5-7 days. 2·5 g. chitin was olubilized in 7 days when present in 1% conentration. With added asparagin, there was a eavier and quicker growth of cells in less an 24 hours but the first signs of chitin digeson were noticed in 6-7 days by the 'frilled' dges, and chitin was digested in 10 days. With dded yeast extract (0·1%), chitin was not igested though fair growth was obtained. ikewise, when glucose was added to the ineral salts—chitin medium, there was slight urbidity in 18 hours but no further growth or hitin digestion was noted upto 2 months. The ulture did not utilize glucose and ammonium ulphate as sole source of carbon and nitrogen espectively. However citrate, acetate and tarrate were readily utilized if ammonium sulhate was present as nitrogen source. Oxalate id not support growth.

The decomposition of chitin by these cultures as followed by paper chromatography. Neither lucose, glucosamine, nor acetyl-glucosamine ere detected. Acetic acid was not also detected. t is to be presumed that glucose and acetic cid are rapidly and preferentially utilized as hey were formed. This opinion was also exressed by Campbell and Williams.[7] Valdecamp[5] id not detect glucose but detected acetyllucosamine, glucosamine, acetic acid and mmonia. Hackman[6] detected acetylglucosamine and a trace of glucosamine but oBell and Rittenberg[4] noted ammonia, acetic cid and 'reducing sugars'. They considered hat this was due to hydrolysis of acetylated mino groups in two steps or by an attack on he essential carbon atom itself. Ammonia ormed was probably in excess of requirements and was hence detected by us. From the culture medium with chitin as the sole source of carbon and nitrogen, we detected an acid with a low R_f value of 0·25-0·28 (R_{Malic} 0·43) in acid solvents (*n*-Butanol—20% formic acid, 4 : 5) but with a higher R_f value of 0·45 when developed in the presence of ammonia.[8] This acid may have a basic group such as OH, and it is still unidentified. The same 'spot' was obtained in media with citrate, acetate and tartrate as carbon sources and ammonium sulphate as source of nitrogen.

The occurrence of these chitinoverous bacteria in chanks herein and the isolation of similar bacteria by Jenniaux[6] (Hackman) from the gut of snail (*H. Pomatia*) indicate the symbiotic role they may play in aiding animals in the digestion of chitin.[4] The culture is deposited in the National Collection of Type Cultures, Poona.

The author acknowledges with pleasure the keen interest evinced and the valuable suggestions given by Sri. R. Venkataraman.

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OCCURRENCE OF *SYNCHYTRIUM MINUTUM* IN INDIA

Synchytrium minutum (Pat.) Gaum. was first recorded by Sydow[2] for India in 1914 as *Woroninella puerariæ* (P. Henn) Syd. Thirty years later, Mhatre and Mundkur[1] could not trace any herbarium specimens of this species in any Indian herbaria and up to the present time the record of its occurrence in India is unsubstantiated.

In June 1950, the author collected this fungus on *Pueraria tuberosa* DC. in the rain forests near Sagar, Mysore State. As has been well known, the fungus produces two distinct phases during any one growing season, *viz.*, the repeating phase of several soral generations and a single generation of dormant soral phase. The sori of repeating phase are soft, spherical, 600-800 μ in diameter and orange-yellow. The

sporangia, several hundred in a sorus, are enclosed by a thin hyaline soral membrane. The dormant sori begin to develop about a month after the primary infection. They incite an unusual type of tumours which are hard, smooth, orange to dull brown and individually measure 3-7 × 3-5 mm. The sori are single in a cavity, hard, black, spherical, oval or elongate, and measure 0·8-1·0 × 0·6-1·5 mm. The sporangia are polygonal to spherical 20-32 (26) in diameter, light golden-brown, and compactly adhere together to form a hard and dark spore-ball. Specimens collected in March 1952 and stored for 3 years in herbarium sheets extrude the sporangial mass forcibly on wetting. It is therefore probable that at least in Malnad where the temperature variation for the whole year is around 50-90° F., the dormant phase is capable of hybernating in the dead host parts.

Previously, this fungus has been reported from China, India, Japan, New Guinea and Philippines on *Pueraaria* sp., *P. phaseoloides* (*P. sericans*), *P. hirsuta* and *P. thunbergiana*. The present record adds *P. tuberosa* to this list.

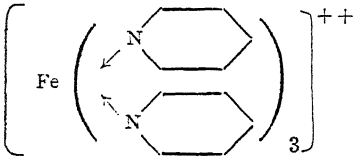
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DIPYRIDYL PARAMOLYBDATE

A SOLUTION of α-α'-dipyridyl in hydrochloric acid gives a pink soluble complex with ferrous salt and this was assigned the structure[1]



A bivalent argentic cation was stabilised[2] by forming a complex with dipyridyl. In the present work addition of dipyridyl solution to an aqueous sodium molybdate solution gave no precipitate and the pH was 8·8. Dilute HCl was added dropwise to this mixture of solutions and a white precipitate was formed at a particular stage when the pH of the solution was 1·92. Recent X-ray investigations[4] and spectrophotometric measurements[5] revealed the presence of $[Mo_7O_{24}]^{-6}$ ion in paramolybdates. According to Jander,[3] $[Mo_6O_{21}]^{-6}$ is stable in solution at about pH 1·5. After pH 1, the anionic molybdenum becomes a divale molybdenyl cation, MoO_2^{++}. According to t above analogy, the white precipitate obtain may be supposed to be $[MoO_2(dipy)_3]Mo$ since it is tested and found not to conta chloride. This is untenable since the MoO_2 ion and $MoO_4^{=}$ ion are stable in acidic a alkaline ranges. Hence the precipitate shou be a dipyridyl paramolybdate having one the following compositions:

1 $[(Dipy\cdot H_2)\ (H_4Mo_6O_{21})]$ —— 179
2 $[(Dipy\cdot H_2)_2\ (H_2Mo_6O_{21})]$ —— 205
3 $[(Dipy\cdot H_2)_3\ (Mo_6O_{21})]$ —— 231
4 $[(Dipy\cdot H_2)\ (H_4Mo_7O_{24})]$ —— 174
5 $[(Dipy\cdot H_2)_2\ (H_4Mo_7O_{24})]$ —— 196
6 $[(Dipy\cdot H_2)_3\ (Mo_7O_{24})]$ —— 218

The theoretical amount of the compound th contains one gram atom of molybdenum is ind cated against each one of them. A definit weight of the dried sample (0·1506 g.) wa taken, heated strongly and finally ignited wit concentrated nitric acid. The white residue molybdic oxide, MoO_3, was cooled and weighe (0·1091 g.). The results obtained in a numbe of experiments are fairly concordant and ind cate that one gram atom of molybdenum present in 198·8 g. of the compound. Th points to Formula No. 5 and thus indicates th presence of a Mo_7 unit in the paramolybdate

This conclusion has also been arrived at b other investigations which will be reporte elsewhere.

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SHARK SPOILAGE BACTERIA*

WHILE the bacterial flora associated with spoilage of teleosts has been extensively studied elasmobranch spoilage flora has received little attention. Wood,[2] who investigated the bacteriology of shark spoilage, found the spoilage flora differing significantly from that of teleosts He found that in the sharks there was no succession in the bacterial genera during spoilage there was also a marked difference in the ratio of genera and species associated with teleosts

and elasmobranchs respectively. In shark spoilage enrichment of certain genera, particularly gram-positive types, occurs, this being different from teleost spoilage where gram-negative types predominate in the later stages.[1,3] In the light of these findings our observations on bacteria isolated from spoiling shark muscle appear to be of interest.

A number of bacterial strains were isolated from twelve shark samples (*Scoliodon* spp.) allowed to spoil at room temperature (27-30° C.) for 24 hours. With the exception of one (a *Micrococcus candidus* strain) all the isolates were gram-negative rods (Table I). None of the isolates produced any pigment and most of the strains required sea-water for satisfactory growth especially in liquid media. Gram-positive asporogenous rods of the *Corynbacterium* group which were found occurring abundantly during shark spoilage studies by Wood (162 out of 266 total isolates being Corynbacteria), were conspicuously absent in the flora isolated by us. Apparently enrichment of gram-positive types, if any, were present initially, had not occurred. Wood found Corynbacteria commonly occurring in estuarine muds in Australia, and since sharks are bottom feeders the presence of these bacteria in the shark muscle during spoilage is only to be expected. In a study of the bacterial flora of the inshore environment at Mandapam carried out by one of us,[4] Corynbacteria were not encountered. These observations incidentally stress the significance of the bacterial flora of the environment of the living fish as a source of the spoilage bacteria.

It is interesting to record here that in contrast with our observations on shark spoilage flora, in our studies on teleost spoilage occurring at room temperature we found aerobic sporeformers, *i.e.*, *Bacillus* as the dominant type.

The relatively high concentration of urea in elasmobranch muscle, about 2% in the case of shark, might exert a selective action on the development of the spoilage flora.

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June 27, 1955.

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TABLE I

Types of bacteria isolated from spoiling shark muscle

Type	No. of strains	Description	Nitrate reduction	Gelatin liquefaction	B.C.P. Milk	Dextrose	Lactose	Hydrogen sulphide production	Ammonia from Urea
I	4	Gram-negative, motile, short rods; show bipolar staining	+	−	No change	Acid & gas	Acid only	−	+
II	1	do (Sometimes long chains present)	+	−	do	do	do	−	−
III	1	Gram-negative, actively motile, medium rods	+	+ (24 hrs.)	peptonised	−	−	++++ (24 hrs.)	+++
IV	1	Gram-negative, short rod & coccoid cells. Non-motile	+	+	Acid; curdled	Acid only	−	−	+
V	2	do	+	+	Alkaline; peptonised	do	−	+	+
VI	3	do	+	+	do	do	−	−	−
VII	6	do	+	+	No change	do	−	−	−
VIII	8	Gram-negative, short rods, in chains and singles. Motile	+	+	peptonised	do	−	−	−
IX	1	Spherical cells, in pairs and clusters. Gram-positive. Non-motile	Identified as *Micrococcus candidus*						

SYNTHESIS OF ASCORBIC ACID BY *FUSARIUM VASINFECTUM* ATK.

THE few reports that have appeared on the production of ascorbic acid in fungi seem to be confined to *Aspergillus niger*[1,2] and some unidentified molds.[3] The possibility of its synthesis by *Fusarium vasinfectum* Atk. and the role of zinc in the process, have been investigated and are briefly reported here.

The fungus was grown at room temperature (30-32° C.) in a purified and heavy metal amended, sucrose-nitrate basal medium,[4] with the Zn concentrations varying. Ascorbic acid

produced in the culture filtrates was estimated at intervals of 5, 10, 15 and 18 days, following the method of Robinson and Stotz,[5] using, however, a 'Spekker' absorptiometer.

Appreciable amounts of ascorbic acid were detected in normal cultures receiving a sufficient amount of Zn, in the early stages of growth—9·28 mg./l. with 0·4 p.p.m. Zn, at the end of 5 days. The corresponding amount noticed in the case of Zn-deficient culture was only 4·99 mg./l. In all the series studied the amount diminished considerably with age, falling to as low a value as 1·9 mg./l. at the end of 18 days. Thus it is clear that ascorbic acid is synthesized by this organism, in appreciable quantities in the early stages of growth, and that Zn has a role in the process.

Fuller details of this and certain other metabolic processes as well, of this fungus, will be published elsewhere.

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ESSENTIAL AMINO ACID CONTENT OF BUFFALO MILK

THE eight amino acids shown[1] to be essential for human adult, were assayed by microbiological methods as suggested by Barton-Wright.[2] The values as presented in Table I are in good agreement with those reported by Rao and Basu.[3] It may be calculated from the data obtained by Mitchell and Hamilton[4] that for nitrogen equilibrium of an adult weighing 70 kg., 28 g. of egg protein per day are required. Taking buffalo milk as the sole diet, it will be seen from Table I that for theoretical considerations, 1,000 ml. (ca. 2·2 lb.) of fluid milk, *i.e.*, about 38 g. of milk protein, as against 28 g. of egg protein, would fulfil the minimum daily requirements of an adult. This is so because comparatively milk protein is deficient in methionine content. Since the recommended daily intake[1] of essential amino acids is double the amount of the minimum daily requirement of each acid, 2,000 ml. (ca 4·4 lb.) of fluid milk (*i.e.*, about 76 g. of milk protein) would not only satisfy the maximum essential amino acid requirements of an adult but would also allow the synthesis of the non-essential amino acids which are also of importance in human physiology. The Food and Nutrition Committee of the National Research Council of U.S.A. has recommended[5] a daily protein intake of 70 g. for a human adult. Since milk protein has a good 'digestibility coefficient', a daily intake of 2,000 ml. of milk as a source of dietary protein, would readily supply essential amino acids not only of proper quality but also sufficient in quantity to meet the demands of basic catabolism as well as those of the anabolic processes associated with the growth and maintenance.

TABLE I

Amino-acid	(*a*)	(*b*)	(*c*)	(*d*)
Tryptophan ..	0·068–0·069	0·25	0·5	1·39
Leucine ..	0·36 –0·39	1·1	2·2	7·2
Isoleucine ..	0·19 –0·21	0·7	1·4	3·8
Valine ..	0·20 –0·23	0·8	1·6	4·0
Lysine ..	0·26 –0·30	0·8	1·6	5·2
Phenylalanine ..	0·17 –0·19	1·1	2·2	3·4
Methionine ..	0·11 –0·12	1·1	2·2	2·2
Threonine ..	0·17 –0·18	0·5	1·0	3·4

(*a*) Amino acid content of buffalo milk (Fluid) in g. per 100 g. (*b*) Minimum daily requirements of human adult[1] in g. (*c*) Recommended daily intake[1] of essential amino acids. in g. (*d*) Essential amino acids as supplied by daily intake of 2,000 ml. (ca. 4·4 lb.) of buffalo milk (Fluid) in g.

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SEXUAL DIMORPHISM IN THE MALPIGHIAN TUBULES OF *GRYLLOTALPA AFRICANA*

THE excretory system of *Gryllotalpa africana* Beauvois (Arthoptera : Insecta) consists of a large number of Malpighian tubules opening into a thick tube, the ureter, which discharges into the gut. The tubules show active twisting movements, while the ureter shows contraction and expansion. In the male there are two types of tubules, while in the female there is a third type in addition to those found in male. Thus there is sexual dimorphism in the Malpighian tubules.

The three types of tubules are easily distinguishable, *viz.*, (*i*) the tubules with yellow pigment, (*ii*) tubules containing white granules, and (*iii*) tubules filled with white amorphous powder. Preliminary tests reveal that the chemical nature of the contents of the three types of tubules is also different.

(*i*) The yellow tubules are delicate, all of them are not of the same size, some are very long while others are small. Their length varies from 3·5-5·5 mm., however there is no difference in their thickness which is about 0·05 mm. except the 0·4 mm. distal part which is very thin and hair-like. The yellow pigment is probably riboflavin.

(*ii*) The second type of tubules are the smallest, pointed at their distal end and more or less conical in shape. Each tubule is about 2·5 mm. long and about 0·05 mm. thick, and contains pellet-like granules. The granules are smallest at the distal end of the tubule but become larger and larger as the proximal end is approached. When the granules are discharged in the ureter, the empty tubule appears transparent. Chemically they are uratic granules, and their size varies from 50-100 μ in length.

(*iii*) The third type of tubules, which are present only in females, are the stoutest, thickest, and longest and are about 40 in number. Each tubule is about 6 mm. long and about 0·1 mm. thick. The whole tubule, except the distal portion which is only about 0·03 mm. thick, contains an amorphous powder the calcium carbonate each particle of which is about 3·5 μ in size and more or less spherical.

The ureter has been found to contain only the uratic granules which are discharged into the gut by the contraction and expansion movements.

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Lucknow, *May* 2, 1955.

PARASITISM OF *AMBASSIS RANGA*, H.B. BY *ARGULUS SIAMENSIS* SUBSP. *PENINSULARIS* RAMKRISHNA

RAMKRISHNA[1] originally described this subspecies from Rajahmundry (S. India), but he did not make any record of its host. The present is, therefore, the first record of a host for this sub-species.

On 20th September 1954, during the survey of the fish fauna of Gokalpur Lake, 4 miles S.E. of Jabalpur, 3 specimens of adult *Ambassis ranga* were collected along with many other fishes. One of these *Ambassis ranga* was found to be infected with *Argulus* at the base of the caudal fin on the left side of the fish. On identification it was found that the parasite belonged to *Argulus siamensis* subsp. *Peninsularis* Ramkrishna.

The author's thanks are due to Dr. J. P. Harding of the British Museum (Natural History) and to Dr. B. S. Chauhan of Zoological Survey of India for their helpful suggestions.

Dept. of Zoology, R. B. MALAVIYA.
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LECANIODIASPIS AZADIRACHTAE GREEN, IN SOUTH INDIA

THE genus *Lecaniodiaspis* has been recorded from widely separated localities such as Australia, Formosa, China, Japan, Ceylon, Egypt, South Africa, America and Europe. Two species, *Lecaniodiaspis azadirachtæ* and *L. malaboda*, were recorded by Green.[1] Later he added one more species *Lecaniodiaspis mimusopis* to his Ceylon collections.[2] In South India, only three genera—*Anomalococcus*, *Cerococcus* and *Asterolecanium*—belonging to the family *Asterolecaniidæ* have been recorded so far. In the course of collecting some species of Coccids from the Agricultural College Estate, Coimbatore, the existence of the genus *Lecaniodiaspis* came to light, and this is apparently the first record of this genus in South India.

The specimens were collected on *Azadirachta indica* during May 1953 and June-July 1954, and later identified as *Lacaniodiaspis azadirachtæ* Green. This species was first described by

Green from specimens collected from a young branch of *Azadirachta* from Jaffna in Ceylon. In the present case, specimens were collected from young and grown-up trees in the farm area of the Agricultural College. They occur on the mid-vein of leaflet or the main rachis of the imparipinnately compound leaf or on the newly-formed branch. The area surrounding the spot, where the insect fixes itself to the host, swells gradually into a gall-like structure with the central portion sunk, forming a shallow pit in which the insect rests concealed completely by an opaque test. Adult females are light yellow in colour and narrow near the cephalic region and broader behind, when mounted on the slide somewhat circular. Sclerotization of the derm is in an advanced state in the fully grown adults and this starts from the posterior region. The eggs are small and yellow in colour, the length ranging from 0·28-0·38 mm. and the breadth ranging from 0·14-0·16 mm. The larvæ are typically Lecanoid in form with well-developed legs and six-segmented antennæ. A detailed description will be presented later after further study.

The author is grateful to Dr. W. J. Hall, Director of the Commonwealth Institute of Entomology, and Dr. W. J. Williams, of the same Institute, for identifying the specimen and to Sri. K. P. Ananthanarayana Iyer, Government Entomologist, Coimbatore, for help rendered during this work.

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ROOT-KNOT DISEASE OF JUTE IN WEST BENGAL

ROOT-KNOT disease of Jute (*Corchorus olitorius*) was first reported by Bessey[1] in 1911. Later on Kundu[2] reported gall-like swellings due to nematodes in *Corchorus capsularis* and *C. olitorius*. Galls due to *Meloidogyne* were observed by Franklin[3] on roots of *C. capsularis* sent to her from Borneo.

Jute plants (*C. capsularis* and *C. olitorius*) grown in West Bengal are sometimes attacked with a disease which is characterized by the stunted growth of the plants with leaves, particularly the young ones, rugose, dull and slightly mottled in appearance. From external appearance, plants are often mistaken to be attacked with Jute mite [*Hemitarsonemus latus* (Bark.) Swing. Order-Acarina]. Closer examination of affected plants never reveals the presence of mite. As the disease progresses the leaves lose their shining green colour. There is premature shedding of lower leaves leaving a small crown of dull and rugose leaves at the top. The attacked plants rapidly lose their remaining leaves, stem becomes shrivelled and they ultimately succumb to the attack of the disease. On uprooting the affected plants it is observed that the root system is heavily galled. It is full of small round to spindle-shaped galls of varying diameter of 0·2-0·5 cm or more. The galls which involve the entire root are present on the tap root and laterals. They are more numerous on roots of young plants.

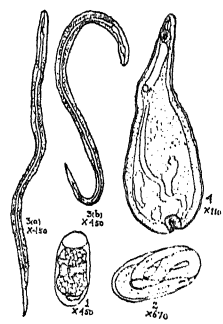


FIG. 1. showing the egg larvæ and adult female of *Meloidogyne incognita* present in the galled roots of Jute (*Corchorus olitorius*).

(1) egg; (2) larva developing within egg; 3 (*a*) and (*b*) young larva before sexual differentiation; (4) mature female.

The disease is evident in the field when the plants are about 3-4′ in height. Mortality is higher in younger plants. The adult plants which survive, present an etiolated, defoliated and dull appearance.

Examination of the galls under the microscope by teasing them shows the presence inside of numerous egg-masses in different stages of development, mature females and a few males of nematodes. Eggs are ellipsoid measuring 81-108 $\mu \times$ 33-40 μ. Larvæ in the initial stage measure 250-370 $\times$ 8-11 μ. The mature female is pear-shaped in appearance measuring 0·48-1·2 mm. $\times$ 0·4-0·8 mm. with a neck 0·16-0·32 mm. and stylet 10-12 μ. The nematodes belong to the genus *Meloidogyne* and they are identified as belonging to the species *Meloidogyne incognita* (Kofoid and White) Chitwood. The species was formerly known as *Heterodera marioni* (Cornu) Goodey, but recently Chitwood[4] placed *Heterodera marioni* under the genus *Meloidogyne* and made five species and one variety of it.

Our sincere thanks are due to Dr. M. T. Franklin of Rothamsted Experimental Station, England, for identification of the nematode and supply of certain valuable references and information.

State Agric. Res. Inst., S. B. CHATTOPADHYAY.
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CONTROL OF RED ROT OF SUGARCANE

RED ROT occupies the most important place among sugarcane diseases of Northern India. Butler's view[1] of "clean setts and no red rot" no longer holds good. Chona[2] emphasised the role of secondary infection in the propagation of the disease. Red rot lesions on the leaf midrib are an important source of inoculum. In the rainy season spores from the acervuli on the midrib wash down into the leaf-sheath where they find favourable conditions for germination and infection of the stem through the nodal region. In his presidential address to the Development Section of the Second Biennial Conference of Sugarcane Research and Development Workers Sri. K. L. Khanna suggested the possibility of controlling red rot by reducing the occurrence of midrib lesions of the leaves through spraying of fungicides. To study such possibilities the sites for spraying were selected at Biswan, Faizabad and Gola, where red rot frequently occurs. The fungicides used were Dithane, coppesan, Blitox and Perenox. Three sprayings were done between July and September at intervals of about four to six weeks. The dosage was two pounds of the fungicide to one hundred gallons of water. About 100-150 gallons of spray solution were required per acre. The observations were recorded in the following manner. In a treatment one cane was taken at random from one stool and the total number of healthy fully opened leaves and those showing midrib lesions were recorded. One hundred canes were thus examined from different parts of the field. Thus the percentage of leaves showing midrib lesions was obtained. To determine the average length of the midrib lesions one leaf was picked up from each stool taken at random and 400 leaves were collected from different parts of the field. Out of this sample of 400 leaves, 100 were picked up at random and the length of the midrib lesions recorded.

TABLE I

Zone	Variety	Plant Ratoon	Treatment	% of leaves showing midrib lesions	Length of the midrib lesions
Biswan	Co. 453	Ratoon	Coppesan	11·3	31·9
,,	,,	,,	Control	12·3	65·1
,,	,,	Plant	Coppesan	10·1	37·9
,,	,,	,,	Control	15·2	48·3
,,	Co. K. 30	,,	Coppesan	10·4	35·9
,,	,,	,,	Control	11·8	41·2
Gola	Co. S. 245	,,	Perenox	15·1	44·9
,,	,,	,,	Control	17·3	42·6
,,	,,	,,	Dithane	15·0	37·2
,,	,,	,,	Control	17·3	42·6
,,	,,	Ratoon	Perenox	12·3	45·4
,,	,,	,,	Control	17·8	66·5
,,	,,	,,	Dithane	11·6	30·2
,,	,,	,,	Control	17·8	66·5
Faizabad	Co. 617	Plant	Blitox	34·8	23·5
,,	,,	,,	Dithane	35·2	35·2
,,	,,	,,	Control	39·3	60·6

Note —'Control' mentioned in the above table refers to unsprayed fields.

The data in Table I gives some indication of the beneficial effects of spraying by Blitox and Dithane. The varieties showed differences in their response.

It often becomes necessary to reject varieties on account of their susceptibility to red rot in spite of their being promising from the agronomical standpoint. The scope for moderately susceptible varieties could be widened if it becomes possible to obtain a comparatively disease-free environment by the above treatments, since the chances of their becoming a prey to red rot will be minimised. The results obtained in the preliminary experiment on spraying of fungicides give indications of possibility of obtaining such conditions by reducing the red rot lesions of the midrib. Soil infection could also thus be minimised to some extent as the leaves falling on the soil would not have much viable inoculum. Further work as regards the usefulness of the spray and its economic aspect is in progress.

Our thanks are due to Dr. R. K. Tandon for his guidance and to the Indian Central Sugarcane Committee which partly finances the scheme under which this work was done.

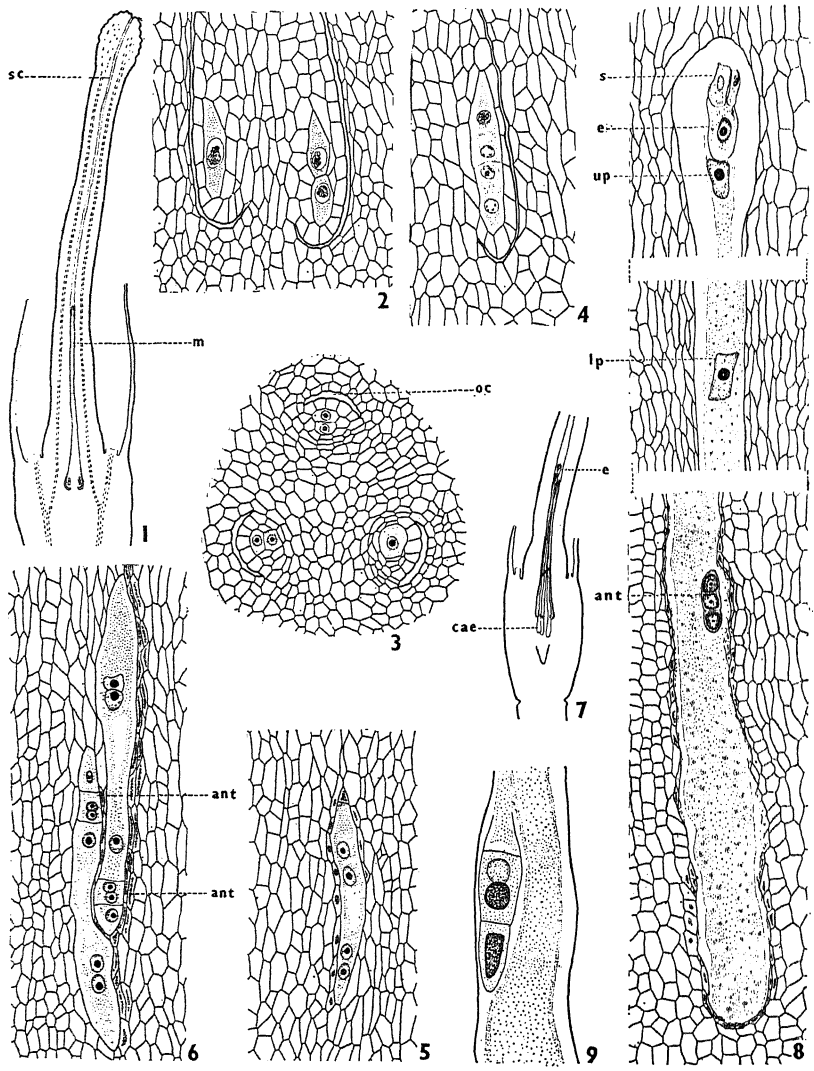
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THE EMBRYOLOGY OF *LEPEOSTEGERES GEMMIFLORUS* BL.

THE present investigation on *Lepeostegeres gemmiflorus* is based on the material collected by Prof. P. Maheshwari in 1952 from the Botanical Gardens, Bogor (Indonesia).

The development of the mamelon is of special interest as it differs from that in other members of the Loranthoideæ. Longitudinal sections of young buds show a mound-shaped projection, arising from the base of the ovarian cavity. At the megaspore mother cell stage nearly 1 mm. of its apex extends into the base of stylar canal which is approximately 2·3 mm. at this time. For some time there is a more or less concurrent elongation of the style and the



FIGS. 1–8

(*ant* = antipodal cells; *cæ* = cæcum; *e* = egg; *lp* = lower polar nucleus; *m* = mamelon; *oc* = ovarian cavity; *s* = synergids; *sc* = stylar canal; *up* = upper polar nucleus.)

Fig. 1. L.s. ovary and style to show the mamelon (diagrammatic), × 24. Fig. 2. Part of same enlarged to show megaspore mother cells in each lobe, × 243. Fig. 3. T.s. ovary showing 3 lobes of the mamelon, × 243. Fig. 4. Dyad cells in telophase, × 243. Fig. 5. Four-nucleate embryo sac, × 243. Fig. 6. Two 6-nucleate embryo sacs in the same lobe, one shows inverted polarity, × 243. Fig. 7. L.s. ovary and a part of style to show 3 elongated embryo sacs (diagrammatic), × 9. Fig. 8. Upper, middle and lower parts of the embryo sac marked 'e' in Fig. 7, enlarged to show the egg apparatus and upper polar nucleus, lower polar, and the antipodal cells respectively, × 243. Fig. 9. Schæppi & Steindl's (1942) text-fig. 8 *h*.

mamelon but later the style grows more rapidly and when it is 14 mm. long, the mamelon has reached its maximum height of about 3·5 mm. It is 3-lobed in cross-section and in between the lobes it remains fused with the wall of the ovary so that the latter appears 3-chambered (Fig. 3).

One to four hypodermal archesporial cells differentiate in each lobe of the mamelon. After elongation they function directly as megaspore mother cells (Figs. 1, 2) and undergo the usual reduction divisions producing linear tetrads (Fig. 4). The basal megaspore (*i.e.*, the one towards the base of the ovary) is functional and by two successive divisions it develops into a 4-nucleate embryo sac (Fig. 5). Due to an earlier division of the 2 lower nuclei, a 6-nucleate stage precedes the usual 8-nucleate condition (Fig. 6). The 4 nuclei at the basal end give rise to the lower polar nucleus and 2 antipodal cells of which the subterminal is 2-nucleate (Figs. 6, 8).

In one case two 6-nucleate embryo sacs were found in a single lobe of the mamelon. One of them was quite normal while the other showed inverted polarity (Fig. 6).

The tip of the embryo sac rapidly extends upwards. It contains 2 nuclei which often lag behind slightly but ultimately reach the apex and divide to form 4 nuclei which give rise to the egg apparatus and the upper polar nucleus (Fig. 8). Three to four embryo sacs grow side by side but they do not extend beyond the mamelon (Fig. 7). Their upper ends reach up to a height of only about 2 mm. in the 25-30 mm. long style. At their lower ends the embryo sacs form cæca which reach down as far as the base of the collenchymatous tube. The antipodal cells are left behind *in situ*, attached laterally (Fig. 8), and can be seen until the cellular endosperm has well advanced.

Polar fusion was not observed but it is presumed that it takes place in the upper part of the embryo sac which is situated in the style. The primary endosperm nucleus moves down to the lower end of the embryo sac which is situated in the ovary. A cellular endosperm develops simultaneously in 3-4 embryo sacs and later a fused composite endosperm is formed as in the other Loranthoideæ.

Several biseriate proembryos pass through the composite endosperm, and extend down to the base of the collenchymatous tube. Only one of them continues further growth while the others abort. Due to a coiling and twisting of suspensor cells the embryo is later pulled up to a more central position and is surrounded by the endosperm. Its further development occurs here.

The globose fruit contains a 6-lobed endosperm and each lobe shows a small conical projection both at the apex and at the base. The dicotyledonous embryo is enclosed by the endosperm except at its radicular end. The cotyledons are slightly unequal and do not fuse as in some other Loranthoideæ. A true radicle is absent. One of the fruits contained 2 embryos of which one was much smaller. The major part of the fruit wall is distinguishable into three zones—an outer fleshy coat followed by a parenchymatous and a vascular zone. The viscid layer is limited only to the base of the fruit.

In conclusion it may be stated that *L. gemmiflorus* has a well developed mamelon somewhat resembling the lobed mamelon of *Macrosolen*,[4] *Lysiana*[5] and *Nuytsia*.[7] In *Amyema*,[1] *Dendrophthoe neelgherrensis*[6] and *Helicanthes*,[2] the mamelon is devoid of the basal lobes, while in *Dendrophthoe falcata*,[10] *Taxillus*,[9] *Barathranthus*,[9] *Scurrula*,[9] *Helixanthera*[3] and *Tapinanthus*[8] a mamelon is absent. Schaeppi and Steindl (1942), who studied *L. gemmiflorus* earlier, did not pay much attention to the development of the mamelon and also missed the 6-nucleate condition of the embryo sac. Their Fig. 8*h* (reproduced here as Fig. 9), interpreted as a proembryo, appears to be the antipodal end of an embryo sac.

I am indebted to Dr. B. M. Johri and Prof. P. Maheshwari for their constant encouragement, help and guidance throughout the course of this study.

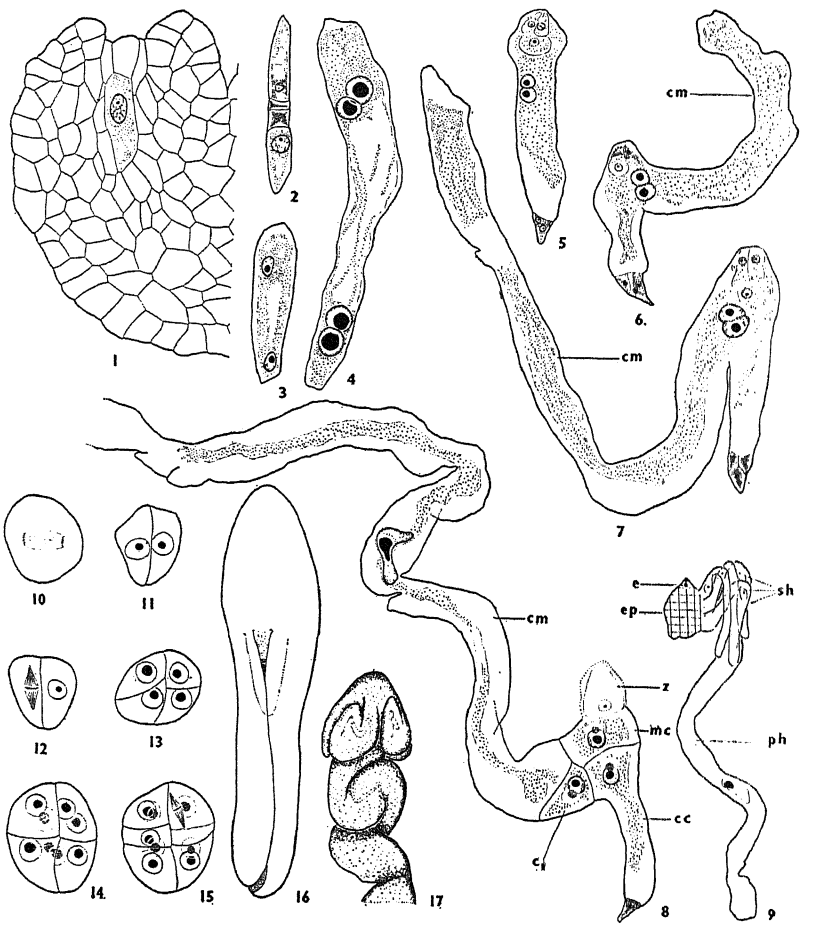
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THE EMBRYOLOGY OF *COMANDRA UMBELLATA* (L.) NUTT.

THE embryology of the family Santalaceæ has not yet been adequately studied and the development of the female gametophyte, endosperm and embryo is variable in different genera. Rao[3] mentions that in *Santalum album* it is the micropylar megaspore of the tetrad which functions whereas in *Scleropyrum wallichianum* "the functional megaspore appears to be the distal one of the tetrad". The embryo sac is stated to conform to the Polygonum type in *Thesium rostratum*,[4] *T. divaricatum* and *Osyris alba*,[5] and to the Lilium (= Adoxa) type in *T. montanum*.[6] In *Santalum album*[2,3] and *S. pyrularium*,[1] the micropylar end of the embryo sac grows out of the ovule, elongates upwards in the direction of the stylar canal, and comes to lie just below the tip of the placental column. A chalazal cæcum (which arises laterally slightly above the level of the antipodal cells) invades the placental tissue, follows a tortuous course and enters the base of the ovary. In *Thesium*, *Osyris* and *Scleropyrum* the micropylar end of the embryo sac does not grow beyond the ovule and only the chalazal cæcum is formed.[3,6]

Comandra umbellata is an American member



FIGS. 1–17.

cc = chalazal chamber; *cm* = cæcum; *e* = embryo; *ep* = endosperm proper; *mc* = micropylar chamber; *ph* = primary haustorium; *sh* = secondary haustoria; *z* = zygote.

FIGS. 4 and 6–17 from dissected whole mounts, rest from microtome sections.

Fig. 1. L.s. ovule showing hypodermal archesporial cell, × 450. Fig. 2. Linear tetrad of megaspores, ×450. Figs. 3, 4. 2- and 4-nucleate embryo sacs, ×450. Fig. 5. Mature embryo sac, only two antipodal cells are seen, ×203. Figs. 6, 7. Same, later stage showing well advanced lateral cæcum, × 203. Fig. 8. Micropylar (*mc*) and chalazal (*cc*) endosperm chambers, a small cell (cc_1) is seen at the base of the cæcum, × 203. Fig. 9. Endosperm proper and primary (*ph*) and secondary (*sh*) endosperm haustoria, ×41. Figs. 10–15. Stages in development of the embryo, ×450. Fig. 16. Mature embryo, × 23. Fig. 17. Placental column bearing ovules; the position of the embryo sacs is shown by dotted lines, ×5.

of the family Santalaceæ and has not yet been investigated embryologically. The anther wall comprises the epidermis, fibrous endothecium, a single ephemeral middle layer and the glandular tapetum. Reduction divisions are simultaneous and quadripartition of the microspore mother cells takes place by furrowing resulting in tetrahedral and decussate tetrads. The mature pollen grains are triradiate with 3 germ pores and are shed at the 2-celled stage.

The semi-inferior, unilocular ovary has 2-4 ovules borne on a free central, twisted placental column (Fig. 17). The ovules are pendulous, anatropous, unitegmic and tenuinucellate. The nucellar cells are not clearly distinguishable from the integumentary cells except at the micropylar end.

A hypodermal archesporial cell differentiates in the nucellus and functions directly as the megaspore mother cell (Fig. 1). A linear tetrad is formed and the chalazal megaspore divides to give rise to an embryo sac of the Polygonum type (Figs. 2-5). Two to four embryo sacs, one in each ovule, develop concurrently. A little before or at the time of fertilization, a lateral cæcum (*cm*) arises from the funicular side of the embryo sac, at a level only slightly below the egg apparatus (Figs. 6, 7). It grows through the ovule, enters into the placental column and passes along the vascular strand. In microtome sections it is impossible to obtain a full view of the entire embryo sac with its cæcum. Dissected whole mounts prepared according to a modification of Paliwal's[2] method proved to be very useful.

The first division of the primary endosperm is followed by a wall formed at the junction of the cæcum and the embryo sac. The nucleus of the latter divides again and a smaller micropylar chamber (*mc*) and a larger chalazal chamber (*cc*) are formed (Fig. 8). The former gives rise to the endosperm proper. The chalazal chamber degenerates or sometimes its nucleus may divide to produce a few cells which get incorporated into the endosperm proper.

The division of the primary endosperm nucleus is followed by the appearance of a small oblique cell cc_1 situated between the embryo sac and the cæcum (*cm*). The cæcum functions as the primary endosperm haustorium and its nucleus becomes hypertrophied. The derivatives of the cell cc_1 also start elongating and enter into the placental column. They function as secondary haustoria (*sh*) (Fig. 9).

Paliwal[2] reports that in *Santalum album* endosperms of different embryo sacs fuse to form a composite mass. In *Comandra*, endosperm formation occurs in all the ovules present in the ovary, but it develops to maturity only in one of the embryo sacs.

Due to its aggressive activity the endosperm consumes the integumentary tissue, the placental column and the parenchymatous endocarp. At maturity the fruit wall consists of only the stony mesocarp and the tanniniferous epicarp.

Briefly then, *C. umbellata* shows several interesting features. The ovules are borne on a twisted placental column; unlike other members of the Santalaceæ the cæcum arises close to the micropylar end of the embryo sac, a little below the level of the egg apparatus; the endosperm is cellular and besides the primary haustorium, 4-5 secondary haustoria also develop; the embryo is characterised by the absence of a suspensor; and the mature 'seed' is naked in the sense that the endosperm is in direct contact with the pericarp.

I am indebted to Dr. B. M. Johri and Prof. P. Maheshwari for guidance and criticisms, and to Professors F. Smith (Oregon, U.S.A.), H. R. Totten (North Carolina, U.S.A.), and J. T. Howell (California, U.S.A.) for collecting and sending the material on which this investigation is based.

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REVIEWS

Analysis of Deformation, Vol. II. By Keith Swainger. (Chapman & Hall, Ltd., London), 1954. Pp. xxxvi + 365. Price 70 *sh.*

This volume deals with applications of the theory developed in Vol. I; mathematical rigour is not adhered to. It is made out that very few experimental results pertaining to complex stresses are available, and hence any theory has very little evidence to stand on. The true normal strain defined in Vol. I as stretch per unit strained length and the linear stress-strain relation form the basis of all applications. In some cases approximation has been made in the intuitive, engineering sense and hence the present volume may excite some interest in research engineers, experimentalists and physicists.

In the first chapter, the behaviour of common engineering substances such as steel, copper, brass, rubber and the like, under simple tension both in elastic and plastic ranges has been shown in graphical and tabular forms. The next chapter gives the solution of some simple problems for forces applied only in one direction. Infinitesimal strain theory, finite strain theory as well as plastic strain theories are given side by side to show the behaviour of the specimen.

Chapter III deals with two-dimensional stress distribution in homogeneous elastic, plastic and elasto-plastic material. It also deals with on Poynting effect whose prevalent treatment does not find favour with the author.

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Chapter V is devoted to the formulation of stress-strain relations, equations of equilibrium, compatibility conditions and other general theories in heterogeneous medium. These formulæ are then used to solve some problems theoretically, while the experimental results for these problems are given in Chapter VI. Some more illustrations are to be found in Chapter VII. They include normal and shear loadings on the cylindrical faces of an annulus of elastic substance of restricted isotropy and constant stress-strain parameter, imple tension at infinity on an elastic sheet of restricted isotropy around a circular, cylindrical hole, quadrantal deformed elastic cantilever, right circular hollow cylinder generated from a flat plate, residual stresses in an annulus, two-stress yielding due to pressures in a circular hole in a duralumin plate.

The formulation and solution of three-dimensional problems are given in Chapters VIII and IX. All these formulæ are not derived, but most of them are only stated. For proofs, references are given to Volume I. In Chapter IX, normal loading on hollow and solid elastic sphere has been considered.

Chapter X is concerned with rubber-like deformation and its theoretical interpretation. The capacity of rubber to suffer large elastic strain under quite small applied loads has been the subject of research by both experimentalists and theoretical investigators. For technical applications they can be interpretated by a quadratic strain theory. The works of Cauchy, Green, Seth, Murnaghan, Mooney, Kuhn and Treloar, Rivlin and others have been summarised. Experimental results are also given for comparison with theory.

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Throughout the treatise vector and dyadic methods are used. There are four appendices dealing with vectors, complex variable, finite differences and Fourier series, a list of references and a glossary all of which facilitate the reading of the book, which has many unfamiliar notations.

B. R. SETH.

tective Current Transformers and Circuits. y R. Mathews. (Chapman & Hall, London), 955. Pp. 253. Price 36 *sh.*

'his book is one of a series of Advanced gineering Text-books, published in consul- on with the technical staff of British Thom- Houston Co., Ltd., and is intended mainly current transformer designers and for spe- ists in the design and use of protective gear. covers in a comprehensive manner the im- tant essentials in the design and operation racteristics of protective current transform- —thus bridging a gap between designers of T.'s and of protective systems. The method nulated can be readily expanded and parti- arised to specific problems, and affords a rching insight into them. The method of dern mathematical analysis has been fol- ed by the author and provides a basis for ances in reliable high speed protection by minating a good deal of guess work.

Most books on protective gear either assume t primary current within all relevant circum- nces result in proportional secondary cur- t of like phases, or that departure of un- dictable account will occur which must be et by some external means, such as biased ays, though neither the rationale of such rection, nor an analysis of the expected parture is usually given. The demand for :-acting gear has called for a clear analysis the behaviour of C. T.'s on non-sinusoidal nsient primary currents, to ensure correct formance in the first few cycles after a fault urs. In this book a careful selection of mate- has been made so as to give a consistent l adequate theoretical groundwork and to strate its application to practical and com- nly encountered problems.

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The book though of particular appeal to designers and workers on protective gear is of great interest to advanced students in Electrical Engineering desiring to specialise in this field.

C. S. Ghosh.

Integers and Theory of Numbers. By Abraham A. Fraenkel. (Published by *Scripta Mathematica*, New York), 1955. Pp. 102. Price 2·75 *sh.*

This is the fifth volume of the series of *Scripta mathematica* studies, whose subject is *rational* numbers treated, according to the author, to meet the needs of "gifted high school students" and "college freshmen" among others. However, in our country today, one cannot think of readers being drawn to the book from any level below that of the senior undergraduates, principally in the Honours classes and only exceptionally in the Pass classes. The book has many illuminating general remarks such as, for example, the reiterated one (pp. 32, 52) that, in order to solve a complicated problem which in itself deals only with natural numbers (or generally, any set of ideas), it may be advisable and even necessary to introduce new numbers (or generally, new ideas). The author illustrates this remark by apt examples: Dirichlet's analytical proof of his arithmetical theorem on primes in arithmetic progression, the Desargue theorem on triangles in plane perspective which cannot be proved (without the axioms on congruence) by means of plane geometry alone.

REVIEWS

Analysis of Deformation, Vol. II. By Keith Swainger. (Chapman & Hall, Ltd., London), 1954. Pp. xxxvi + 365. Price 70 *sh.*

This volume deals with applications of the theory developed in Vol. I; mathematical rigour is not adhered to. It is made out that very few experimental results pertaining to complex stresses are available, and hence any theory has very little evidence to stand on. The true normal strain defined in Vol. I as stretch per unit strained length and the linear stress-strain relation form the basis of all applications. In some cases approximation has been made in the intuitive, engineering sense and hence the present volume may excite some interest in research engineers, experimentalists and physicists.

In the first chapter, the behaviour of common engineering substances such as steel, copper, brass, rubber and the like, under simple tension both in elastic and plastic ranges has been shown in graphical and tabular forms. The next chapter gives the solution of some simple problems for forces applied only in one direction. Infinitesimal strain theory, finite strain theory as well as plastic strain theories are given side by side to show the behaviour of the specimen.

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Most books on protective gear either assume that primary current within all relevant circumstances result in proportional secondary current of like phases, or that departure of unpredictable account will occur which must be offset by some external means, such as biased relays, though neither the rationale of such correction, nor an analysis of the expected departure is usually given. The demand for fast-acting gear has called for a clear analysis of the behaviour of C. T.'s on non-sinusoidal transient primary currents, to ensure correct performance in the first few cycles after a fault occurs. In this book a careful selection of material has been made so as to give a consistent and adequate theoretical groundwork and to illustrate its application to practical and commonly encountered problems.

There are mainly two classes of operation for protective gear: (*a*) those which have to work under initial transient conditions, and (*b*) those which operate with time delays such that the transient conditions are ever before the specified operating conditions are reached. While the duration of the primary current transients can be calculated in a given case, that of the secondary depends on the secondary circuit time constant and thus on the C. T. design. Thus it may be that time-delayed relays are assumed to be working under steady state conditions when in fact, due to a longer secondary time constant, they are not. The nine chapters in the book are grouped into two parts on the basis of the above classification.

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The author makes it clear how his four chapters are held together by a single thread. Chapter I ("Natural Numbers as Cardinals") and Chapter II ("Natural Numbers as Ordinals") present the two aspects of positive integers associated with the operations of "counting" and "ordering" respectively, formulating the latter operation in terms of Peano's Axioms; while Chapter II, in conjunction with Chapter IV ("Rational Numbers"), defines the field of rationals for the operations of addition, multiplication and their inverses. Chapter III ("Theory of Numbers") introduces in more or less detail a variety of problems on natural numbers some of which (like Dirichlet's already referred to) may lead us beyond these numbers.

The book is extremely readable throughout. It cannot fail to sharpen the appreciation for mathematics of its readers.

C. T. RAJAGOPAL.

Molecular Vibrations. By E. B. Wilson, Jr., J. C. Decius and P. C. Cross. (McGraw-Hill), 1955. Pp. xi + 388. Price $ 8.50.

The subject of molecular vibrations has grown so much during the last two decades that the absence of a book dealing exclusively with the theoretical methods and concepts used in this field has become a handicap. The book under review fills this gap and it is most gratifying to note that Professor Wilson, who has been one of the pioneers in this field, is associated with it.

An essential requirement of a book of this sort is a sound treatment of the relation between infra-red absorption and Raman scattering by a molecule and the quantization of its vibrational levels. This has been dealt with in this book in such a way as to make it useful for the student learning the subject of light scattering and infra-red absorption by molecules. In a similar way the use of symmetry groups and their irreducible representations in the analysis of vibrations and spectra of complicated molecules is dealt with fairly exhaustively.

Another interesting aspect of the book is the space devoted to the solution of secular determinants. The chapter mentions in outline even the fundamentals and use of electric circuit analogues. This chapter on secular determinants will interest not only theoretical physicists but mathematicians and astronomers as well.

Where it is necessary to delve into more abstract mathematical reasoning, the material has been shifted to appendices which form about a quarter of the bulk of the book. This again makes easier reading possible for those who are not familiar with mathematical detail.

Apart from being an aid to spectral analysis, the theory of molecular vibrations also aims at the computation of the potential function. The chapter devoted to this can be made fuller and admits of further thorough discussion. The discussion of the anharmonic terms in the potential energy is inadequate in view of recent work showing their basic importance.

This book is a valuable one in the scientific literature on the subject and has many merits. It is a most welcome addition to one's library.

S. BHAGAVANTAM.

A Handbook of Hard Metals. By W. Dawihl. (H.M.S.O., London), 1955. Price 25 *sh.*

The volume under review is a British translation of the major part of the *Handbuch der Hartmetalle* by Dr. Dawihl. The Handbook deals with three principal classes of hard metals, *viz.*, sintered alloys of hard carbides to which small amounts of metals have been added, alloys with a tungsten carbide base and hard facing alloys applied by gas or electrical welding to a hard carbide base. The publication opens with a general survey of the subject and of the physical properties of hard metals and their metallography. It goes on to deal fully with the scientific principles of the sintering technique as far as they apply to the production of hard metal.

In the section dealing with production, the organisation of the factory and the works supervision of hard metal production are dealt with and the methods of mixing, milling, sintering and shaping the product are described in detail. The text is supported by diagrams, tables, photographs and photomicrographs.

A Laboratory Manual of Qualitative Organic Analysis. Third Edition. By H. T. Openshaw. (Cambridge Univ. Press), 1955. Pp. xii + 92. Price 10 *sh.* 6 *d.*

This is the third edition of a well-known manual first published in 1946. The principal aim of qualitative organic chemistry, with respect to undergraduate training, is the development of a schematic method for the identification of simple types of organic compounds. The student first learns how to test for various functional groups and then graduates in applying this knowledge to unknown substances containing polyfunctional groups. Detection of constituent elements is a very important step. The

book under review deals with every step in a logical manner and thus enables the student to become thoroughly familiar with the methods. The detection of characteristic groupings, being the most important part of the training, is treated under five sections based on the elements present. These sections are closely linked with each other so that the bearing of one series of tests on others is clearly exemplified. Methods for the preparation of derivatives are treated in a clear and concise manner. A number of tables of physical constants of derivatives are given, and these tables give full information regarding the methods of preparation. In a manual of less than 100 pages the author has succeeded in giving an adequate amount of information and direction to help the student. This manual is so useful practically that it should find a place in the library of every student of organic chemistry.

K. N. MENON.

Advances in Virus Research, Vol. I. Edited by Kenneth M. Smith and Max A. Lauffer. (Academic Press, Inc., N.Y.), 1953. Pp. 1-362. Price not given.

Much progress has been made in recent years in understanding the molecules that constitute the observable viruses of plants, animals, insects and man. The problems that arise out of a study of these minute causal agents are immense and every ingenuity known to men of science have been brought to bear on them in a determined effort to resolve their fundamental structure, properties and behaviour *in vitro* and *in vivo*. Many aspects of these are clearly presented in the volume under review.

The chapters include: The Properties of Bacteriophages; Interactions between Viruses and Virus Strains; Transmission of Plant Viruses by Cicadellids; Insect Viruses; Multiplication of Influenza Virus; Polimyelitis; Purification and Properties of Animal Viruses and Virus Nucleic Acids. There are many spectacular electron micrographs of important purified viruses and most authors have clearly set out methodology of investigation in their fields of research. It is evident that fundamental researches in viruses, be they plant or animal in origin, are largely an interpretation of biological behaviour through the rigid techniques available to the scientist in the composite disciplines termed: 'Physical Sciences'. This becomes obvious as one passes on from one chapter to another. The last chapter on nucleic acids serves as a reminder to the already clear picture that the future of most problems of biological interest is linked more and more with their enzyme systems and a study of proteins and nucleic acids. This volume is definitely for the specialist, but I warmly commend it to every experimental scientist. The bibliography could have been uniformly edited in all chapters to include complete titles of papers cited but this is a minor matter.

T. S. SADASIVAN.

The Distribution of Sagitta Gazellae Reitler-Zahony. (*Discovery Reports*, Vol. 27.) By P. M. David. (Cambridge University Press), 1955. Pp. 235-78. Price 15 *sh.*

The volume under review is a valuable contribution to our knowledge of the principles which underline the distribution of oceanic organisms.

Sagitta Gazellae has a continuous circumpolar distribution in Antarctic and Sulantaxtic waters. The taxonomic difference of this species from *S. lyra* which has a worldwide distribution in tropical and subtropical waters are discussed in relation to the different maturity stages. The species is both epiplanktonic and mesoplanktonic, and occurs even at depths of 3,000 metres, though the maximum numbers occur between 100-50 metres. There is no diurnal migration; however, in the antarctic area there is a seasonal migration to levels deeper than the horizon of the shallow oblique nets. The paper also has notes on the rate of growth observed from the sizes of different broods, normal maturity size (55-60 mm.) being reached in 12 months. Notes on the food of these chætognaths are also given. On the whole, this contribution to the *Discovery Reports* might well form a pattern for repors on single species of animals found in a collection.

C. P. GNANAMUTHU.

Bhartiya Bhootatwa Ki Bhoomika. By Sm. Akhilandeshwari. (Hindi translation of *Introduction to the Geology of India*, by Dr. M. S. Krishnan.) (M/s. Higginbothams, Ltd., Madras), 1955. Pp. xii + 238. Tables 23, Figs. 13. Price Rs. 8.

The book under review is a translation of Dr. M. S. Krishnan's well-known volume, which is a standard text-book meant for junior students of geology. The translator has added two useful appendices to the book; the first one consists of 42 pages and gives brief expla-

natory notes on common terms and names used in palæontology, structural geology, mineralogy and petrology, and the second one gives the glossary of English geological terms with their Hindi equivalents used in the book.

Most of the descriptive terms have been translated in Hindi and the specific names of minerals, rocks and fossils have been retained as such, but written in both Hindi and English characters. The readers may not agree with the Hindi renderings of some of the common terms. For example, the term 'crystal' has been translated as मणिज instead of स्फटि or the more common word रवा 'Ore' is translated as धातु which actually means in Hindi 'metal'. According to Dr. Raghuvira, the word 'ore' itself is derived from Sanskrit अयस and he has coined अयस्क as the Hindi term for ore. In any case, if it be not possible to use two separate words for metal and ore, the ore may be termed as असंस्कृत धातु.

In the present stage of our Hindi terminology, we need not, however, be particular of such usages. It is the reviewer's view that the terminology of equivalents for English scientific words in Hindi and other Indian languages will finally evolve itself after the medium of instruction in the Universities (at least up to the Graduate stage) has been adopted as the language of the State. It will be then that amongst the different words used by different authors in the scientific books published in Hindi and other Indian languages, the most popular word will automatically gain currency and will be adopted by the Indian scientists.

The book can very well be prescribed as a text-book in the Universities of Northern India where geology will be taught with Hindi as the medium of instruction in the near future. It will now be very easy to translate the book into Tamil, Telugu and Canarese, etc., so that it may be adopted as a text-book in the Universities of Southern India as well.

The author deserves to be congratulated for service rendered to the cause of Hindi by bringing out this book. The publishers have also to be thanked for the nice get-up.

N. L. S.

Books Received

A Manual of Paper Chromatography and Paper Electrophoresis. By Richard J. Block, Emmet L. Durrum and Gunter Zweig. (Academic Press, Inc.), 1955. Pp. v + 484. Price $ 8.00.

Advances in Enzymology, Vol. 16. Edited by F. F. Nord. (Interscience Publishers, Inc.), 1955. Pp. v + 584. Price $ 11.00.

Principles of Animal Virology. By F. M. Burnet. (Academic Press, Inc.), 1955. Pp. x + 486. Price $ 10.00.

Animal Nutrition. By E. J. Sheehy. (Macmillan & Co.), 1955. Pp. vii + 732. Price 30 *sh.*

Analysis of Insecticides and Acaricides—Chemical Analysis, Vol. 6. By Francis A. Gunther and Roger C. Blinn. (Interscience Publishers, Inc.), 1955. Pp. xi + 696. Price $ 14.00.

The Book of Indian Birds. By Salim Ali. (The Bombay Natural History Society, Bombay), 1955. Pp. xlvi + 142. Price Rs. 20.

Modern Text-Book of Intermediate Physics, Vol. 1. By A. N. Banerjee. (Dasgupta & Co., College Street, Calcutta), 1955. Pp. viii + 528. Price Rs. 6.

A Brief Text in Astronomy. By William T. Skilling and Robert S. Richardson. (Chapman & Hall), 1955. Pp. viii + 327. Price 32 *sh.*

Perspectives and Horizons in Microbiology. Edited by Selman A. Waksman. (Rutgers University Press, New Jersy), 1955. Pp. x + 220. Price $ 3.50.

New Methods in Analytical Chemistry. By Cecil L. Wilson. (Chapman & Hall), 1955. Pp. xii + 287. Price 30 *sh.*

Origins of Resistance to Toxic Agents. Edited by M. G. Sevag, Roger D. Reid, Orr E. Reynolds. (Academic Press Inc.), 1955. Pp. xv + 471. Price $ 12.00.

Introduction to Paper Electrophoresis and Related Methods. By Michael Lederer. (Elsevier Publishing Co.), 1955. Pp. xii + 206. Price 37 *sh.* 6 *d.*

DDT PRODUCTION IN INDIA

NORMAL DDT production has now been started at the Hindustan Insecticides Factory, near Delhi, and is expected to reach an output of 2 tons per day by the end of 1955. For 1956, the U.N. Children's Fund has allocated the sum of $ 275,000 which will double the output of this factory to reach a target of 1,400 tons of DDT per annum. All these supplies will be used by the various Indian State Governments in anti-malaria operations under the national control programme, which has been assisted by many pilot projects undertaken jointly by UNICEF and the World Health Organization.

SCIENCE NOTES AND NEWS

Necator americanus sp. in an Indian Pangolin

Shri S. N. Sharma, Department of Zoology and Entomology, Assam Agricultural College, Jorhat, reports the occurrence of *Necator americanus* sp. in the intestine of an Indian Pangolin (*Manis aurita*). Several workers have already reported this species in different wild and domestic animals, but this is the first authentic record of the species occurring in this animal. The worms slightly differ in structure from the *Necator americanus* reported by Stiles (1902-03), in man and primate.

Gas Diodes for Computers

With the increasing use of electronic digital computers, complex problems have been presented which require for their solution high-speed "memories" so large that present-day costs make them economically impractical. The cold-cathode gas diode, such as the simple neon glow lamp, offers possibilities for low-cost high-speed memories, once the inherent disadvantages of the tubes are overcome. A. W. Holt and D. C. Friedman of the National Bureau of Standards have undertaken a study of these visual-indicating tubes for memory and indicator circuits. The result has been a number of circuits that provide an approach to reducing the cost of digital computer memories from the present dollar per bit (binary digit) to about 10 cents.

Fat Accumulation in the Periportal Regions of the Liver

Interest in the distribution of fat within the liver lobule has been stimulated by the observation that in the widespread disease kwashiorkor the stainable fat is found predominantly in the periportal regions.

In this connection, Prof. Best and colleagues report in a recent issue of the *British Medical Journal* (1955, June 18, p. 1439) that, whereas animals receiving choline-deficient diets developed fat accumulation round the central lobular veins, animals receiving protein-deficient diets developed fat accumulation in the periportal regions. Periportal accumulation of fat was not dispersed by adding choline to the diet. The different sites of fat accumulation were clearly defined only in the early stages of deficiency. When either choline or protein had been deficient for a long time, fat accumulation extended throughout the whole lobule. The significance of these findings is not clear, though Best and his colleagues think that accumulation of periportal fat when the diet is deficient in protein may be due to qualitative and quantitative alterations in the amino acids present. They also noted a transient increase in periportal fat when an animal was transferred from a diet low in protein to one containing adequate quantities of protein and choline.

Synthesis of Testosterone

The first direct synthesis of testosterone from simple coal-tar products has been accomplished by a group of chemists at the University of Wisconsin. The research that led to the synthesis was carried out by W. S. Johnson and a colleague, Raphael Pappo, visiting Lecturer in Chemistry from the Weizmann Institute, Israel, in co-operation with Brian Bannister and E. J. Pike. The project is part of a broad research program at Wisconsin for the synthesis of hormones involved in sex, pregnancy, and the life-maintenance substances produced by the adrenal glands.

The only practical method to date for synthesizing testosterone has required that a complex natural steroid such as cholesterol be used as a starting point. Johnson and Pappo synthesized the sex hormone from the coal-tar product 1, 6-dimethoxynaphthalene. However, they have emphasized that the method is not practical in its present form.

Amino Acids in Fossils

Amino acids have been found in fossils in studies at the Geophysical Laboratory of the Carnegie Institution of Washington. Philip H. Abelson has shown that the occurrence of proteins in hard parts of recent creatures is widespread, and that under favourable conditions of preservation fossils may contain amino acids after as long as 360 million years. Among the compounds found are alanine, glycine, valine, leucine, aspartic acid, and glutamic acid. In studying thermal stabilities Abelson found that the rate of degradation of amino acids is sharply increased with increasing temperature, suggesting the possibility of a recording geological thermometer for sediments.

International Computation Centre

The UNESCO is sponsoring the establishment of an International Computation Centre in Rome. The projected centre, a laboratory equipped with the best available mechanical

devices for calculation, will have three main functions: scientific research, training of experts through a system of fellowships, and the provision of services to organizations and persons who, under certain conditions, will be authorized to request calculations required to solve unusually complex scientific, technical, administrative, or financial problems.

Palaeontological Society of India

With a view to organise and promote advanced studies and research in the field of palæontology and allied sciences including prehistoric archæology, a "Palæontological Society of India" has recently been founded with Dr. M. R. Sahni, Palæontologist, Geological Survey of India, as its first President. The Society will endeavour to organise a permanent Field Survey of expeditions to selected areas for the collection of material for research on special topics of pure and applied palæontology, and will eventually try to build up an up-to-date All-India Palæontological Library and Museum.

An important part of the Society's activities will be the publication of a Journal containing authoritative papers on the pure and applied aspects of palæontology and allied sciences, with special reference to India; Prof. L. Rama Rao of Bangalore, former Professor and Head of the Department of Geology in the Mysore University, will be its Chief Editor. The Inaugural Number of the Journal which is to be published shortly will contain more than 25 papers contributed by leading workers from India, U.K., U.S.A., Europe, S. Africa, Ceylon and Australia, on diverse aspects of current palæontological research.

Award of Research Degree

The University of Bombay has awarded the Ph.D. Degree in Chemistry to Sri. R. Rama Rao for his thesis entitled "Biochemical Studies on Experimental Malaria (Avian—*P. gallinaceum*).

The University of Poona has awarded the Ph.D. Degree in Agricultural Meteorology to Shri Klaus Raschke, for his thesis entitled "A Method for the Micrometeorological Measurement of the Energy-Budget of a Leaf *in situ*".

The University of Nagpur has awarded the Ph.D. Degree in Botany to Shri V. R. Dnyansagar for his thesis entitled "Embryological Studies in the Leguminosæ".

Plant Ecology in Arid and Semi-Arid Regions

Reports on plant life in ten of the world's arid and semi-arid regions are presented in "Plant Econogy, Reviews of Research", a new publication in UNESCO's series on arid zone research (Price $ 7.00). The reports are presented in one bilingual volume in French and English. Each report is accompanied by a bibliography and a synopsis in the other language. The wide geographical range as well as the suggestions for future investigations make this publication of great value to ecologists and others who have to deal with arid and semi-arid regions.

Symposium on Alloy and Special Steels

A symposium on 'Production, Properties and Applications of Alloy and Special Steels' will be held on February 1st, 2nd and 3rd, 1956, under the auspices of the National Metallurgical Laboratory at Jamshedpur. The objects of the symposium will be four-fold: (*i*) to draw attention to the usefulness of stepping up this industry along scientific lines, (*ii*) to indicate to the engineering industries, such as, automobile, railway, defence, aircraft, chemical industries, the need to rationalise demands and fall in with specifications of alloy steels which can be made from Indian raw materials, (*iii*) to define satisfactory grades of alloy steels based on such alloying elements as are indigenously available in India, and (*iv*) to discuss special equipment and practice required in steelworks for producing these steels and the materials, including ferro-alloys, involved in their production.

Invitations are being extended to technologists and scientists here and abroad to contribute technical papers for the proposed symposium. Equipment for the projection of slides and drawings will be available. Further particulars can be had from the Director, National Metallurgical Laboratory, Jamshedpur.

International Committee of Zoologists

A Nine-man International Committee of Zoologists has been set up by the International Union of Biological Sciences to co-ordinate zoological teaching and research with Prof. R. Sparck (Denmark), Prof. J. G. Baer (Switzerland), Dr. C. F. A. Pantin (England), Dr. M. B. Lal (India), Prof. P. Drach (France), Prof. U. d'Ancona (Italy), Prof. W. A. Ankel (Germany), Prof. E. Le Loup (Belgium), Dr. Ernst Mayr (U.S.A.) as Members.

Dr. Lal is a Fellow of the Indian Academy of Sciences and Professor and Head of Zoology Department at the University of Lucknow.

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ATOMS FOR PEACE AND PLENTY

THE International Conference on the Peaceful Uses of Atomic Energy, which concluded its sessions recently in Geneva, may be said to have fully realised the expectations which it raised. For, apart from its great contribution to the easing of political tensions and paving the way for freeer flow of research information among scientists of all countries, its significance as a scientific conference can hardly be overestimated.

As was pointed out by Dr. H. J. Bhabha, President of the Conference, during its opening session, humanity is in the third great epoch of its history, each of which was marked by a change in the energy pattern of society. It was the unaided human muscle which supplied all the energy for mechanical work during the first epoch, while the second one, which dawned somewhere in the 17th century, ushered in the widespread use of chemical energy in the form of coal and oil. But the energy consumption in the world has gone up in a staggering manner during the three recent centuries, and it is the atom, as the Conference has clearly established, which holds the answer to most of the problems connected with the demand for such supply during the third epoch which we are just entering into.

The present Conference is perhaps the largest ever organised by the United Nations on a subject of universal importance, and was attended by nearly 1,300 scientists, representatives and advisers from 73 countries. Space permits us to make only a brief mention of some of the highlights of the Conference in what follows.

The chief series of discussions in the first few days brought out the economic need for nuclear power in a world in which "conventional" fuel resources are running low, and

foreseeable other resources, such as those of hydro-electric power, are inadequate for the increasing demands of an industrialized world. Nuclear power, it would appear, has come just in time to enable coal and oil to be more widely used in the chemical and allied industries.

The general background to the employment of this new world power source was traced in papers from two of the UN specialised agencies. That submitted by WHO discussed the general problems of protection against radiations from the public health point of view. Potential dangers were considered as coming from two main sources: firstly, in radioactive wastes from reactors, and secondly, on account of the increasing distribution and use of radioisotopes. One point which was brought out was that the long-lived by-products of reactors are likely to be in such demand for many years to come that their disposal is not expected to become a problem for some years to come. Above all, it was emphasized, protection must depend on education, not only of the necessary personnel for this new work, but also of the general public.

The second of these general papers dealt with the possible results of the application of atomic energy to increasing production in agriculture, forestry and fisheries. This paper, presented by FAO, reviewed the whole field and stressed the fact that while it would be some time before cheap nuclear power was available in sufficient quantity to make a direct contribution, there was already a vast field in which radiation, and even more, radio-isotopes, were contributing to speed up production through their use as research tools. In fact, it was suggested that the value of nuclear energy in helping to feed, clothe and house the rapidly increasing population of the world might be even greater than its importance as a new source of power.

Of the papers in the first of three technical sections of the Conference, those dealing with nuclear physics and with reactors gave a complete survey of the progress made so far in these important fields. In this connection there was a series of announcements from physicists of UK, USA and USSR which showed that in all three countries, almost identical results had been obtained for one of the fundamental measurements in this field, namely, the number of neutrons emitted per fission. The greater the accuracy with which this number is known, the more efficiently can nuclear energy be used.

On the reactor side, descriptions were given of many types of reactors already in use, ranging from small research reactors to those so far built for actual power production. Beyond this, detailed plans were disclosed and discussed which show that many of the smaller nations, such as the Netherlands and Norway, are already well advanced and making important original contributions in this field. Though at present research reactors are attracting most attention, they will soon be followed by the design and construction of prototype reactors for power production. But it will be sometime before full-scale nuclear power plants are in operation, except in one or two countries where plans are already very well advanced. A catalogue of reactors so far built was contained in a paper submitted by UNESCO, which summarized the available information to give a complete picture of the situation in this respect.

Another highlight of the Conference was the demonstration of the importance of thorium for the production of atomic energy and the possibility of a positive gain factor in the conversion of fertile to fissile material in the thorium-U233 system which was shown to be superior to the uranium 238-plutonium system in several ways. The breeding of atomic fuel in fast neutron reactors also held out exciting possibilities.

The second technical group of sessions, dealing with chemistry, metallurgy and technology, opened with a general review of the natural occurrence of uranium and thorium, from which emerged the encouraging picture of a plentiful supply of these essential raw materials—a picture which was based on no less than 94 papers submitted to this session. Prospecting problems and techniques were discussed with special reference to aerial survey methods. Less familiar aspects of the chemistry of fission, and problems of handling the highly radioactive materials produced in the fission process were also dealt with in a number of papers.

In the biological and medical sessions, medical applications of radioisotopes, ways and means of handling these materials, clinical and diagnostic work were some of the more important subjects dealt with. Advances in this field were evident in many countries.

Discussions ranged from such public health problems as the study of epidemic communicable diseases to the application of isotopes in studying the biochemistry of muscles. Later, various aspects of radiation injury were dealt

with, during which there was discussion of the possible effects of a general increase in the level of radio-activity in the world as a whole. From these discussions it was evident that the use of radioisotopes in medicine is one of the outstanding contributions which nuclear energy is already making to the welfare of mankind.

On the general side, the feasibility of generating electricity by atomic energy was demonstrated beyond doubt, and the economics of atomic power generation was also greatly clarified. There would appear to be good reasons for expecting that capital costs of atomic power stations would come down during the next decade. Even with present costs, it was shown, atomic power stations would be economically competitive with power stations of a conventional type in many areas of the world where power costs are high.

Certainly the meeting of the world's specialists in the atomic sciences marked a new departure in international co-operation and was not marred by politics. It will go down in history as a major achievement of the United Nations.

PROF. M. S. THACKER

PROF. M. S. THACKER has been appointed Director, Scientific and Industrial Research. He took charge of his office on August 3, 1955.

Prof. Thacker received his early education in Ahmedabad and Bombay, and proceeded to Europe at an early age. He graduated in engineering from the Bristol University and undertook post-graduate research in the Department of Electrical Engineering of the same University. Later, he joined the Bristol Corporation Electricity Department as an engineer. He returned to India in May 1931 and joined the Calcutta Electric Supply Corporation, Calcutta, as a covenanted officer. He continued there till 1947, when he was invited to take up the Professorship of the newly created Department of Power Engineering, Indian Institute of Science, Bangalore. In 1949, he was appointed Director of the Institute.

Prof. Thacker is the author of numerous papers and memoirs in the field of power technology and high voltage engineering. During the past eight years, he has actively participated in a number of international conferences and committees as an expert delegate from India.

He has also been intimately associated with many scientific and technical organizations in India and assisting several States in the development of power resources and distribution of electricity supplies. His counsel has been much sought by numerous committees and boards concerned with research and technological education and by several Universities in the country and outside. On the last Republic Day the President conferred on Prof. Thacker the award of *Padma Bhushan*.

We wish Prof. Thacker success in his new assignment.

DIRECT CONVERSION OF RADIATION INTO ELECTRICITY

PRODUCTION of electricity by direct conversion of atomic energy should be considered as a possible auxiliary power source, according to Dr. Ernest G. Linder, Paul Rappaport and J. J. Loferski, of the Radio Corporation of America, in a paper presented to the International Conference on Peaceful Uses of Atomic Energy at Geneva.

Discussing various known methods of converting atomic energy directly to electrical energy, Dr. Linder gives particular attention to the semi-conductor type of device employing radioactive material in conjunction with materials such as silicon or germanium—the method used in the experimental atomic battery announced by RCA in early 1954. In this type of conversion unit, high current multiplication is achieved in the semi-conductor material. For example, each beta particle produced by strontium-yttrium-90 radioactive source material produces in turn about 200,000 new electrons as it penetrates a silicon target, increasing output current and reducing internal impedance by a similar factor. However, power sources using radioactive material cannot be considered truly practical until solutions are found to problems of high cost of radioactive material, efficient shielding, radiation damage to target material bombarded by beta particles, and low efficiency.

At the present time, the available isotope nickel-63 meets all of the requirements except that of cost, but it is hoped that attention will be given to this and other materials in the same category.

TRICHY PHOSPHATIC NODULES: NEW POSSIBILITY OF EXPLOITATION AS PHOSPHATIC FERTILIZER

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Agricultural Research Institute, Coimbatore

THE Trichy phosphatic deposits, estimated at 8 million tons,[1] is found spread over an area of 10 square miles to a depth of 200' near Utathur Village of Ariyalur taluk in Tiruchirapalli District of the Madras State. The phosphatic material is available in the form of nodules and contains about 25·6% P_2O_5 and 17% $CaCO_3$. The phosphate in the nodules is in a form not readily available to plants due to its very low citric solubility. Attempts have been made since 1892 to convert this rich source of phosphatic material into mono-calcium phosphate as in superphosphate using sulphuric acid, so as to be available to plants. It was estimated that in the process, only 35·44% of the sulphuric acid was profitably utilised for the conversion of tricalcium phosphate to mono-calcium phosphate, while 37·68% was wasted in reacting with calcium carbonate and iron and aluminium oxides present as impurity in the raw material. This resulted in the cost of super prepared from this material to be nearly 2·5 times higher than super prepared from other sources. Consequently, the method proved highly uneconomical. However, the latest techniques in the processing of phosphate rocks have given methods in which the sulphuric acid process could be avoided. Of the various processes available, it was felt that the conversion to 'phosphate-rock-magnesium silicate glass' might best serve to render the phosphorus in Trichy nodules available to plants for reasons of economy and usefulness. Such a product would be similar to the silicophosphate used by the authors in a previous study[2] to combat phosphate reversion in lateritic soils of the Nilgiris.

The present study was therefore directed towards finding out the most suitable ingredients containing magnesia and silica for obtaining a highly citric soluble fertilizer from the Trichy nodules.

Pure salts of magnesia and silica were used at first and were later substituted, as far as possible, by cheaply available raw materials such as olivine and serpentine obtained from the magnesite mines at Salem.

Selected nodules giving a P_2O_5 content of 28% were powdered to pass through a 50-mesh sieve and mixed thoroughly in a mortar with the other components under study, using a small quantity of water to facilitate pelletting. Pellets of the size of playing marbles were made and were dried in an oven at 150° C. The fusion of the mixture is generally done in a triple arc furnace at 1550° C.[3]; but as this facility was not available locally, oxy-acetylene flame was used in all mixtures studied, excepting for Mixture No. 34 which was fused in a graphite arc at the Electro-Chemical Research Institute, Karaikudi. The pellets were placed on a firebrick and fused one by one in the oxy-acetylene flame. The hot fused mass was immediately quenched in cold water.

The fused product thus obtained was powdered to pass through a 90-mesh sieve and analysed for "total P_2O_5", which was estimated volumetrically after digestion with a mixture of 1 : 1. HCl to which a few ml. of HNO_3 was added, while "available P_2O_5" was estimated in the 2% citric acid extract (Wagner's method).

The results are presented in Table I.

TABLE I

Showing the total and available P_2O_5 in the different fused products

Mixture No.	Composition of mixture	Total P_2O_5 %	Available P_2O_5 %	P_2O_5 rendered soluble in 2% citric acid as % of total
7	10 : 6-T.P : $MgSO_4$	29·57	4·83	16·33
12	10 : 6-T.P : Na_2SiO_3	19·15	7·70	40·22
6	10 : 3 : 3-T.P : $MgSO_4$: Na_2SiO_3	23·42	12·75	54·44
16	10 : 6-T.P : Olivine	19·68	5·66	28·76
19	10 : 6-T.P : Serpentine	19·74	5·73	29·02
22	10 : 3 : 3-T.P : Olivine : $CaSO_4$	22·15	5·60	25·28
27	10 : 3 : 3-T.P : Olivine : Na_2SO_4	19·70	14·10	71·57
23	10 : 3 : 3-T.P : Serpentine : $CaSO_4$	22·15	5·60	25·28
34	10 : 3 : 3-T.P : Serpentine : Na_2SO_4	21·65	20·65	95·33

(T.P. stands for Trichy phosphatic nodules)

From these data the following conclusions may be drawn :—

(*i*) Of the pure salts tried, a mixture of magnesium sulphate and sodium silicate is superior to either of them alone.

(*ii*) The olivine and serpentine rocks of Salem can be used as sources of magnesia and silica, but these by themselves were not sufficient to bring about the maximum solubility of P_2O_5 in the Trichy nodules. The presence of sodium sulphate in the fusion mixture gave the best results and was better than calcium sulphate used in the study.

(*iii*) The fusion of a mixture of 10 : 3 : 3 of Trichy phosphate, serpentine and sodium sulphate, using graphite arc for fusion. has rendered 95% of the phosphate available to plants.

Our thanks are due to Sri. Padmanabhan, Chief Chemist of the Madukarai Cement Factory, and to the Director of the Electro-Chemical Research Institute, Karaikudi, for facilities given for the fusion of the mixtures tried in this study.

1. Sivan *et al.*, *Mem. Dept. Agri. Madras*, 1925, **7**, 162.
2. Mariakulandai, A., Venkatachalam, S. and Rajagopala Iyengar, T., *J. Ind. Soc. Soil Sci*, 1955, **3**, 15.
3. Moulten, R. W., *Chem. Eng.*, 1949, **56** (7), 102.

GENETIC EFFECTS OF RADIATION

THE dangers to man's heredity—the effects on the unborn generations of humans exposed to atomic radiation—may be greater than has been generally supposed, according to Dr. W. L. Russell, of the Oak Ridge National Laboratory, U.S.A., in a paper prepared for the International Conference on Peaceful Uses of Atomic Energy in Geneva, Switzerland.

Dr. Russell states that while the average radiation-induced mutation rate in his experiments with mice was about ten times higher than that in similar experiments with fruit flies, mutation rates from radiation in man are not known. So far, human radiation-induced mutation rates were estimated on the basis of fruit fly results, but it is reasonable to suppose that the mutation rates in man are more like the rates in mice than those in fruit flies. Therefore, calculations of human hazards on the basis of fruit fly mutation rates may have seriously underestimated the damage in man.

Information on another important problem is presented in Dr. Russell's paper. It has sometimes been suggested that the probability that the offspring of an irradiated individual will inherit a mutation might decrease as the interval between irradiation and conception increased, *i.e.*, that there is "recovery" from genetic damage. Earlier work with mice had shown that the probability of transmitting some types of mutations does decrease for a few weeks after irradiation as the father exhausts the germ cells that were irradiated in the later maturing stages.

However, it was not known whether there would be any further decrease after this interval. It was desirable to have this particular problem investigated on an organism such as the mouse which has a life-span considerably longer than that of the fruit fly and which has male sex glands that are anatomically similar to those of man.

Dr. Russell states that analysis of his data on mutations induced in mice showed no significant change in mutation rate with time after irradiation. Offsprings conceived long after exposure of the father to radiation are just as likely to inherit induced mutations as are those conceived a few weeks after exposure. In practical terms, the results of the work on mice indicate that, although postponement of procreation for a few weeks following exposure to radiation would reduce the total risk of transmission of mutational changes, by excluding those induced in the maturing sex cells, further postponement would not give any additional reduction in risk.

It would appear that adequate protection against the genetic hazards of peaceful uses of atomic energy may require a limitation not only of the average dose of radiation received by the population as a whole, but also of the dose accumulated by individuals. It may be added that the magnitude of the first generation effects already observed in mice suggests that it is quite possible that, if the present permissible weekly dose is to be kept, a total accumulated dose limit may have to be established to protect the individual from incurring too great a risk of damage to his own offspring.

STRUCTURE OF DL-ASPARTIC ACID

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IN a recent report,[1] Saito, Cano-Corona and Pepinsky have reported the structure of L-asparagine monohydrate, $[CO(NH_2).CH_2.CH(NH_2).COOH, H_2O]$ in which they find that no cyclic structure is formed by internal hydrogen bonding, although such a structure has been suggested by Steward and Thompson[2] on the basis of the chemical properties of the compound. Aspartic acid $[COOH.CH_2.CH(NH_2).COOH]$ is very similar in constitution and it is possible for a six-membered ring to be produced by one of the hydrogens of the amino group being attached to an oxygen of the carboxyl group by a hydrogen bond. In fact, such a structure has been postulated from chemical considerations by Stehlik and Liskova[3] for aspartic acid.

TABLE I

Co-ordination of atoms in DL-aspartic acid structure

	x	y	z
C_1 ..	0·038	0·161	0·049
C_2 ..	0·079	0·094	0·134
C_3 ..	0·000	−0·017	0·199
C_4 ..	0·027	0·047	0·290
O_1 ..	0·106	0·114	−0·011
O_2 ..	−0·092	0·236	0·094
O_3 ..	0·134	−0·060	0·308
O_4 ..	−0·058	0·154	0·312
N ..	−0·133	0·081	0·208

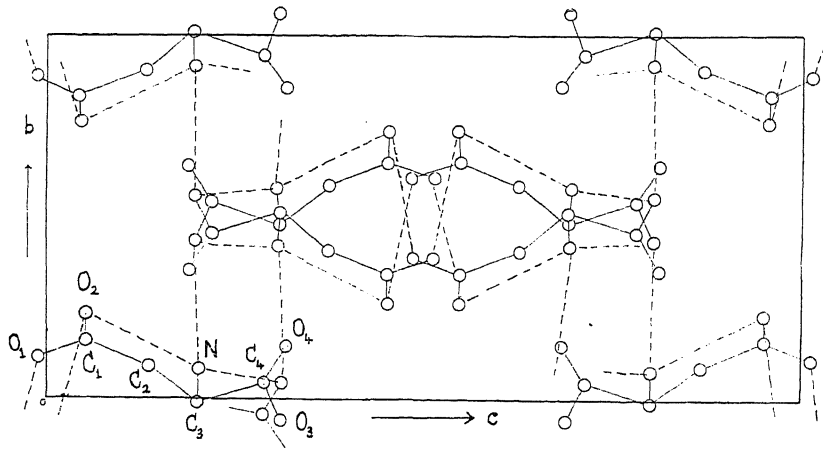


FIG. 1. Projection of structure on (100) plane.

The crystal structure of DL-aspartic acid has been determined by X-ray methods and it is found that an integral hydrogen bond definitely exists in this compound. The crystal is monoclinic with $a = 9{\cdot}18$A, $b = 7{\cdot}49$A, $c = 15{\cdot}79$A, $\beta = 96°$ and belongs to the space group I $2/a$ with 8 molecules per unit cell.[4] The structure was determined by a combination of trial and error methods making use of models, with the Patterson projection along a and b axes and signs determined by inequality methods. Both Fourier projections have large overlaps of atoms and the final positions of atoms were fixed from considerations of bond lengths and bond angles and by making use of an error synthesis. Table I gives the co-ordinates finally chosen; the positions of atoms are expected to be correct to 0·1A. The symbols for the atoms in this table are the same as those marked in Figs. 1 and 2, which give the projections of a unit cell on the (100) and (010) planes. The hydrogen bonds are indicated by dotted lines. The agreement between calculated and observed structure factors is fairly satisfactory, the R-values being 0·25 and 0·20 for the a and b projections.

As will be seen from the figure, (*i*) the molecule of aspartic acid has the zwitterion structure with three hydrogens attached to the nitrogen; (*ii*) one of the three hydrogen atoms is internally hydrogen bonded to the oxygen atom O_2 while the other two are bonded to

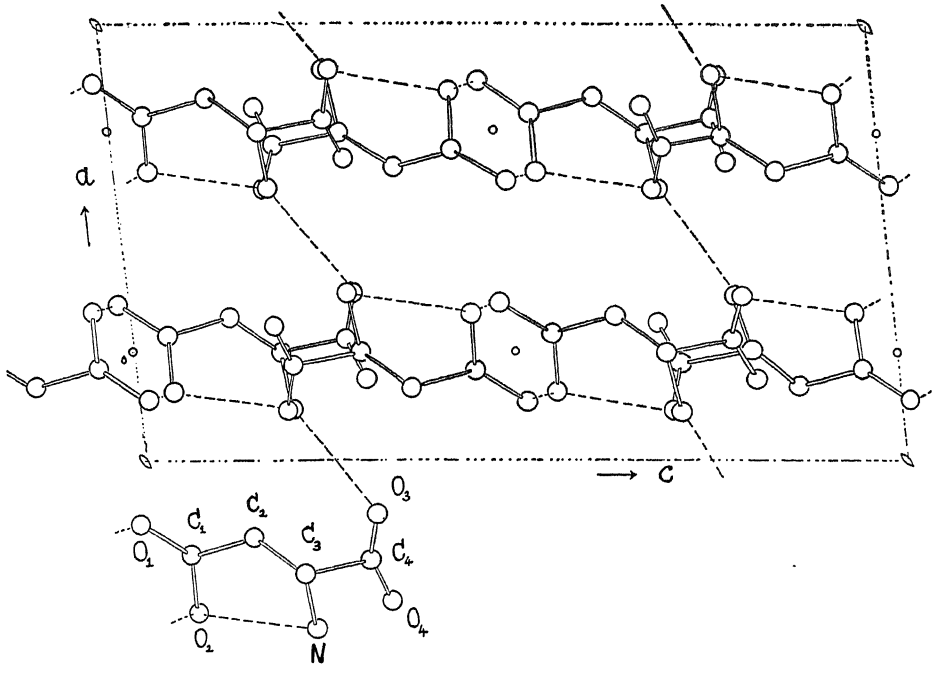


FIG. 2. Projection of structure on (010) plane.

oxygen atoms O_3 of different molecules; (*iii*) the molecule has its chain length nearly parallel to the long axis (c) and two molecules in a line are linked together mutually by means of hydrogen bonds formed between their carboxyl groups.

1. Saito, Y., Cano-Corona, O. and Pepinsky, R., *Science*, 1955, **121**, 435.
2. Steward, F. C. and Thompson, J. F., *Nature*, 1952, **169**, 739.
3. Stehlik, B. and Liskova, N., *Chem. Zvesti*, 1950, **4**, 60
4. Dawson, B. and Mathieson, A. McL., *Acta Cryst.*, 1951, **4**, 475.

THE PHOTOSYNTHETIC CYCLE

IN a paper presented before the International Conference on the Peaceful Uses of Atomic Energy, Professor Calvin of the University of California, Berkeley, U.S.A., has described the theory of a "photosynthesis battery" which has resulted from the researches of his group. The use of radioactive carbon to trace the source of chemical reactions in the plant has given insight into the order in which the plant makes chemicals and the way in which it takes energy from the sun and uses it for the chemical reactions.

By developing precise and delicate methods for separating and measuring the radioactive compounds formed by the plant, Prof. Calvin's group have isolated some fifteen compounds and traced the reactions needed for the complete process from CO_2 to sucrose. Compounds made by the plant in the first few seconds, sometimes in amounts less than a fraction of a microgram, were isolated and measured.

Studies of the carbon reduction cycle have led to a new theory as to how the energy absorbed by the chlorophyll from the sun is used to split the water molecule. This theory proposes an arrangement like a tiny battery, made of layers of chlorophyll between the microscopically thin layers of fat and protein. The battery absorbs sunlight and uses the energy of the sunlight to split the water molecule. The electrons freed from the water are held by a compound believed to contain sulfur until they are used by the enzymes in the carbon reduction cycle.

With this detailed knowledge it is claimed that it should be possible not only to increase crop growth but also to vary the kind of products obtained and to use small plants as factories for the production of concentrated fat, protein or sugar, as desired. With more knowledge of the "photo-synthetic battery" it should also be possible to devise more efficient means of converting solar energy to a form which can be used for power or fuel.

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SAKURADA EQUATION FOR THE INTRINSIC VISCOSITIES OF POLYMER SOLUTIONS

The increase in viscosity η of a polymer solution over that of a pure solvent η_0 is expressed as a fraction called the specific viscosity η_{sp} given by $\eta_{sp} = \eta - \eta_0/\eta_0 = \eta_r - 1$, where η_r is termed the relative viscosity. Intrinsic viscosity of a solution is defined as $[\eta] = \lim_{c \to 0} \eta_{sp}/c$, where c is the concentration of the polymer and is obtained by drawing a graph between η_{sp}/c and c and extrapolating it to $c = 0$. $[\eta]$ is an important constant of the polymer system and it is related to the molecular weight of the polymer. Sakurada[1] proposed for fractions of polymethyl methacrylate solutions that $[\eta] = 3\,(\eta_r^{\frac{1}{3}} - 1)/c$, where c is the concentration in gm./100 c.c. He claimed that this equation was applicable to polymethyl methacrylate fractions up to a value of six for η_r and for some polystyrene fractions also. This equation has the great merit of giving the value of $[\eta]$ with η_r determined at one concentration only and thus saves a lot of labour involved in finding $[\eta]$ by the graphical method. A large amount of viscosity data on fractions of polyvinyl acetate, polystyrene and polymethyl methacrylate is available with the authors in connection with a study of the light scattering behaviour of these polymer systems. Sakurada equation was found to be applicable in all the above cases in the range of η_r values investigated. $[\eta]$ values determined by graphical

method and the Sakurada equation, in some cases, are shown in Table I. The agreement is very satisfactory.

TABLE I

Polymer solution	Name of fraction	η_r	$[\eta]$ from graph 100 ml./g.	$[\eta]$ calculated from Sakurada equation
Polymethyl-methacrylate in acetone	M_1	1·37	1·75	1·75
		1·72	1·75	1·78
	M_2	1·28	2·75	2·78
		1·97	2·75	2·80
Polymethyl-methacrylate in chloroform	M_3	1·53	3·25	3·22
		2·20	3·25	3·28
	M_4	3·37	2·85	2·89
Polystyrene in benzene	S_1	1·35	0·42	0·43
	S_2	2·21	1·10	1·17
Polyvinyl acetate in benzene	V_1	2·15	2·21	2·20
	V_6	2·70	1·47	1·55
	V_9	1·63	0·77	0·77
	V_{10}	1·21	1·25	1·24

The authors desire to express their thanks to Professor S. Bhagavantam for his interest in the work.

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Hyderabad, *August* 5, 1955.

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ADSORPTION OF GLUCOSE FROM AQUEOUS SOLUTIONS ON CELLULOSE

ALTHOUGH the adsorption of a variety of compounds has been studied in case of cellulose, it appears that the adsorption of glucose has received no attention. This study should be of some interest because of the similarity of the structure of glucose and cellulose.

The experimental procedure was as follows: about 1 g. of viscose staple fibre (1·5 denier), on dry basis, was weighed out into a glass-stoppered flask, 50 ml. of glucose solution of known concentration were added, and the flask was kept in a thermostat for 5-5½ hours, with frequent shaking. The solution was then separated by filtering through a very small amount of glass-wool to retain any loose fibres. It was kept overnight before measuring the equilibrium concentration. The concentrations were measured by means of a Hilger and Watts microptic polarimeter reading to 0·01 degree. B.D.H. Laboratory Reagent quality *d* (+) glucose was used without further purification.

The measurements were made at three different temperatures, *viz.*, 20°, 30° and 40° C. The results are presented in Fig. 1.

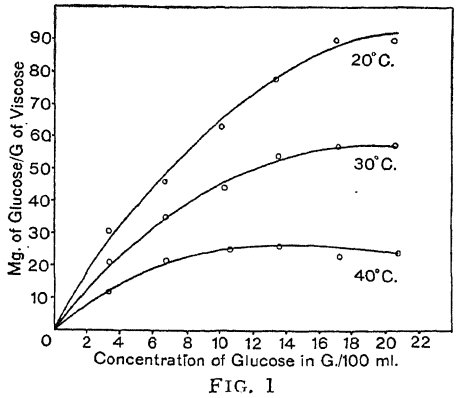


FIG. 1

It is seen that the magnitude of the adsorption is not very large, the maximum at 20° C. for a 20% solution being about 15% on the basis of the amorphous region in viscose. Two reasons can be offered for this behaviour. Firstly, the glucose molecules may not be able to penetrate into the finer pores and so the surface available to them will be limited. The second more important reason is that cellulose may not show any particular preference towards glucose because its affinity for hydrogen bonding substances can also be satisfied by the water from the solution. The molecules of surface-active agents and dyestuffs contain hydrophobic parts which try to drive them out of the solution and so such compounds tend to concentrate at any interface, even the air-water interface in the absence of an absorbent. In the system cellulose-glucose-water, on the other hand, all the components have similar hydrogen bonding properties and strong mutual preference between any two is absent.

As usual, it is found that the adsorption decreases with iscreasing temperature. The effect, however, is quite marked; the adsorption decreases by 60-70% as one passes from 20° C. to 40° C. Also, the maximum value of adsorption is reached at lower concentrations as the temperature is increased.

The results of other workers with dyes and surface-active agents are reported at concentrations which are very much lower than those used here, and so a comparison is not possible.

ATIRA, A. G. CHITALE.
Ahmedabad-9,
July 18, 1955.

BIOSYNTHESIS OF CHOLINE IN THE SEEDLING OF THE CHICK-PEA (*CICER ARIETINUM*)

In a previous report[1] it was shown that the germinating seedlings of *Cicer arietinum* grown in light synthesized choline to a maximum value (3·8 mg./g. of tissues, dry weight) after 96 hours of germination and then gradually declined. It was observed that DL methionine, creatine, acetone and methanol stimulated choline biosynthesis in this plant when their aqueous solutions were used as germinating fluid, presumably by supplying the methyl group or its precursor. Earlier Steensholt[2] found that methyl group of methionine was not utilised by the etiolated wheat seedlings for N-methylation of ethanolamine to produce choline while Barrenscheen and Valyi-Nagy[3] noted that added methionine increased creatine synthesis sixfold to eightfold from guanidoacetic acid by 7-day old wheat seedlings. Kirkwood and Marion[4] reported that on feeding C^{14} labelled formate to sprouting barley, the C^{14} carbon showed up in the methyl group of choline and hordenine. More recently Cromwell and Rennie[5] have found that the biosynthesis of choline was stimulated to a marked degree in the etiolated wheat seedlings when N-methylethanolamine or dimethylethanolamine were fed either alone or in combination with methionine and/or formate. Ethanolamine under the same conditions did not result in any significant increase in the choline content of the tissue. Feeding of formate alone also produced no increase in choline content of wheat.

The present report is concerned with the effect of ethanolamine and formate in the biosynthesis of choline in the chick-pea.

The experimental procedure and methods are as previously described.[1] The seeds were soaked for 12 hours in the neutralised aqueous solutions of the precursors and allowed to germinate for 96 hours on sand-bed. The results are given in Table I.

TABLE I

Effect of ethanolamine and sodium formate on the biosynthesis of choline in the germinating seedlings of Cicer arietinum

Germinating fluid	Choline chloride content of seedlings (mg./g. dry wt)*	Stimulation of biosynthesis†
Water (control) ..	3·84	..
0·01 M Ethanolamine ..	5·23	36·2
0·01 M Sodium formate	4·35	13·8

* Average of 4 determinations; † As per cent. over the control.

It is quite clear that unlike the findings with etiolated wheat seedlings,[5] both ethanolamine and formate when present singly serve as precursors for the biosynthesis of choline in the chick-pea. The use of sodium formate instead of potassium formate was to avoid the stimulatory effect of potassium ion itself.[1] The observation with formate is therefore similar to that made with sprouting barley.[4] While chicks[6] are not able to utilise ethanolamine as a precursor of choline, ethanolamine is readily converted into choline in the rat.[7] The stepwise methylation of ethanolamine is also a metabolic reaction in *Neurospora crassa*.[8] This differential synthetic activity of wheat and chick-pea seedlings is not therefore surprising.

Biochemistry and Nutrition Laboratory, Dacca University, East Pakistan, *February* 14, 1955.

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A. Jabbar.

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THE ROLE OF THIAMINE IN THE BIOSYNTHESIS OF ASCORBIC ACID IN THE RAT

Sure, Theis and Harrelson[1] suggested as early as in 1939 that thiamine may be involved in the biosynthesis of ascorbic acid in the rat. Subsequently, others have confirmed this finding.[2–4] In plants also the necessity of thiamine was shown by Bharani, Shah and Sreenivasan.[5] It is now fairly established that the pathway

Glucose → Glucuronic Acid → Gulonic Acid → Ascorbic acid

represents one of the important pathways whereby this vitamin is synthesized.[6,7] Gulonic acid as a precursor and its position in the reaction sequence has yet to be established conclusively by tracer work.

The work of Roy *et al.*[2] and Mosbach *et al.*[11] suggests that thiamine may have some role either in the synthesis of glucuronic acid or its subsequent conversion to ascorbic acid. In the

present study an attempt has been made to determine whether thiamine has any such role in the biosynthesis of ascorbic acid.

Albino rats, weighing about 100 g. each, were fed a diet of the following composition: casein (vitamin free) 18, sucrose 67, salts[8] 4, gingelly oil 10, vitamin mixture 1. The vitamin mixture was made up of pyridoxine hydrochloride 0·05, riboflavin 0·05, nicotinic acid 0·25, calcium pantothenate 0·25, inositol 0·80, *p*-aminobenzoic acid 0·50, choline chlordie 6·0 and glucose 42·6.

One group of four rats received adequate thiamine (24 γ per rat per day) and served as controls. Another group received instead of thiamine, its antivitamin, neopyrithiamine hydrobromide, orally at a level of 4 mg. per rat per day for a period of one week.

After deficiency symptoms had set in and a steady state reached in the urinary excretion of ascorbic acid, the amount of the vitamin excreted during a twenty-four hour period was determined. The rats were then given glucurone subcutaneously at a level of 100 mg. per rat. The excretion of ascorbic acid, as well as glucuronic acid during the next twenty-four hours were studied. Ascorbic acid was estimated by indophenol titration,[9] and glucuronic acid with naphtho-resorcinol.[10] The results are presented in Table I.

TABLE I

Influence of thiamine deficiency on the utilisation of glucuronic acid

Rat Group	Ascorbic acid Excretion (mg./rat/day) A	Ascorbic acid Excretion (mg./rat/day) B	Mean increase in Ascorbic acid mg.	Glucuronic acid excretion (mg./rat/day)
Controls	0·70–1·30 Av. 0·93	1·10–2·00 Av. 1·58	0·65	62·2–64·4 Av. 63·3
Thiamine Deficient	0·60–0·70 Av. 0·65	0·65–0·90 Av. 0·76	0·11	31·1–37·7 Av. 34·4

A—Before injection; B—After injection.

From the data, it can be seen that the thiamine-deficient organism shows a very much decreased conversion of glucuronic acid to ascorbic acid as compared with normal, showing thereby that thiamine is necessary for the proper utilisation of glucuronic acid for ascorbic acid synthesis.

Further, the thiamine-deficient rats excrete about 45% less glucuronic acid than the controls. It is possible that this is due to an increased catabolism of glucuronic acid in the thiamine-deficient organism, in which case the observed impairment of ascorbic acid synthesis from glucuronic acid may also be, to a certain extent, due to this latter cause. But that this cannot be the primary cause of the observed phenomenon is, however, obvious since the glucuronic acid excretion falls by 45% whereas, under the same conditions, the corresponding fall in ascorbic acid is 84%. Further work is in progress to determine whether in cases of deficiencies of other vitamins of the B-complex where the effect of chloretone is suppressed such an impairment of glucuronic acid utilisation takes place.

The authors wish to thank Messrs. Corn Products Co. Ltd., N.Y. (U.S.A.), for their generous gift of the glucurone used in the above investigation.

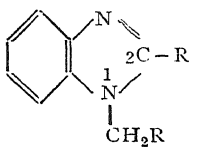
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K. SIVARAMA SASTRY.
P. S. SARMA.

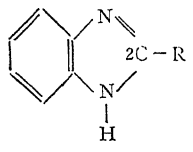
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REACTION BETWEEN *o*-PHENYLENE-DIAMINE AND AROMATIC ALDEHYDES

THE reaction between *o*-phenylene diamine and aldehydes in the absence of any specific oxidising agent was first studied by Ladenburg,[1,2] and later extended by Hinsberg.[3,4] When one mole of the diamine was allowed to react with two moles of aldehyde under acidic conditions, 'aldehydines' or 1 : 2-disubstituted benzimidazoles (I), occasionally accompanied by small amounts of 2-substituted benzimidazoles (II), were found to be formed. Both



(I)



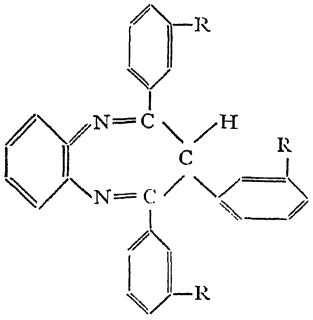
(II)

types of compounds were reported in the case of *m*- and *p*-nitrobenzaldehydes,[4,5] whereas only compounds of type (I) were obtained with benzaldehyde,[1,6] *p*-hydroxybenzaldehyde,[7] vanillin,[6] and anisaldehyde.[2,7] Salicylaldehyde was considered to yield dialdimine.[6]

During our studies on the ease and mode of formation of heterocyclic ring systems containing nitrogen, we had occasion to re-investigate the action of certain aromatic aldehydes on o-phenylene diamine. In addition to the aldehydes already studied, the reaction between 2 : 4-dichlorobenzaldehyde, *p*-bromobenzaldehyde and *o*-nitrobenzaldehyde, and the diamine has now been investigated. The results are summarised in Table I.

The experimental procedure due to Hinsberg[3] has been modified by us to make an effective separation of the small amount of (II) from the major product (I), taking advantage of the difference in their basic nature. Applying this modification, it has now become possible to isolate both (I) and (II) in the case of benzaldehyde, anisaldehyde, *p*-bromobenzaldehyde, and the three isomeric nitrobenzaldehydes. However, *o*-nitrobenzaldehyde has been found to give the 2-substituted benzimidazole (II), as the principal product and 2 : 4-dichlorobenzaldehyde the compound of type (II) only. In the reaction with *o*- and *p*-hydroxybenzaldehydes and vanillin, exclusive formation of type (I) compounds has been noticed.

In the reaction with benzaldehyde, a third compound, which appears to be identical with compound (III) reported by Weil and Marcinkowska,[6] has been isolated. Further, an analogous compound, possibly having the structure (IV), has been obtained with *m*-nitrobenzaldehyde.



(III) R=H
(IV) R=NO_2

TABLE I

No.	Aldehyde	Products isolated		
		1 : 2-disubstituted benzimidazole	2-substituted benzimidazole	Third product
1	Benzaldehyde	1-benzyl-2-phenyl-	2-phenyl-	Compound of m.p. 159
2	Salicylaldehyde	1-(*o*-hydroxybenzyl)-2-(*o*-hydroxyphenyl)-m.p. 220*	..	..
3	*p*-Hydroxybenzaldehyde	1-(*p*-hydroxybenzyl)-2-(*p*-hydroxyphenyl)-	..	..
4	Vanillin	1-(*p*-hydroxy-*m*-methoxybenzyl)-2-(*p*-hydroxy *m*-methoxyphenyl)-	..	..
5	Anisaldehyde	1-(*p*-methoxybenzyl)-2-(*p*-methoxyphenyl)-	2-(*p*-methoxyphenyl)-	..
6	2 : 4-Dichloro-benzaldehyde	..	2-(2 : 4-dichlorophenyl)-	..
7	*p*-Bromo-benzaldehyde	1-(*p*-bromobenzyl)-2-(*p*-bromophenyl)-m.p. 155*	2-(*p*-bromophenyl)-	..
8	*o*-Nitro-benzaldehyde	1-(*o*-nitrobenzyl)-2-(*o*-nitrophenyl)-m.p. 120*	2-(*o*-nitrophenyl)-	..
9	*m*-Nitro-benzaldehyde	1-(*m*-nitrobenzyl)-2-(*m*-nitrophenyl)-	2-(*m*-nitrophenyl)-	Compound of m.p. 195
10	*p*-Nitro-benzaldehyde	1-(*p*-nitrobenzyl)-2-(*p*-nitrophenyl)-	2-(*p*-nitrophenyl)-	..

* Compounds so far not reported in literature.

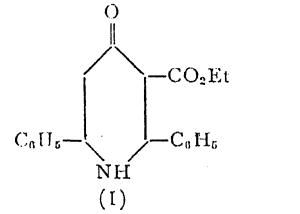
Full details of the investigation will be published elsewhere.

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Osmania University, C. V. RATNAM.
Hyderabad-7, *May* 29, 1955.

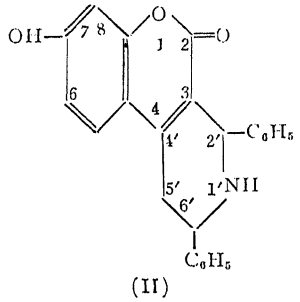
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FUSED HETEROCYCLIC COMPOUNDS FROM 3-ETHOXYCARBONYL-4-PIPERIDONES

THE piperidones[1] resulting from the condensation of ethyl acetoacetate with aldehydes and ammonia have an interesting structural feature. They have the grouping -CO.CH.COOEt
|
which is also present in ethyl acetoacetate and



(I)



(II)

which is responsible for the numerous applications of this ester in organic syntheses. Since many 4-piperidones having this grouping can be prepared by the method of Baliah *et al.*,[1] the synthesis of some interesting heterocyclic compounds can be readily accomplished through their use. The possibilities of such synthetic application are indicated in the present communication by the preparation of 1′ : 2′ : 5′ : 6′-tetrahydro-7-hydroxy-2′ : 6′-diphenylpyrido (3′ : 4′-3 : 4) coumarin (II) from resorcinol and 3-ethoxycarbonyl-2 : 6-diphenyl-4-piperidone (I).

1′ : 2′ : 5′ : 6′-*tetrahydro*-7-*hydroxy*-2′ : 6′-*diphenylpyrido* (3′ : 4′-3 : 4) *coumarin*.—To a mixture of 3-ethoxycarbonyl-2 : 6-diphenyl-4-piperidone (3·2 g.) and resorcinol (1·1 g.) was added concentrated sulphuric acid (5 c.c.) with stirring. After allowing to stand overnight, the product was poured into ice-cold water and the solid obtained was filtered off. The yield was 3·1 g. (84%). Recrystallisation from ethanol gave yellow prisms, m.p. 249-250° (decomp.). (Found: C, 77·8; H, 5·4. $C_{24}H_{19}NO_3$ requires C, 78·1; H, 5·2%.)

7-*Acetoxy*-1′ : 2′ : 5′ : 6′-*tetrahydro*-2 : 6-*diphenylpyrido* (3′ : 4′-3 : 4) *coumarin*.—To a solution of the foregoing compound (1·8 g.) in pyridine (2 c.c.) was added acetic anhydride (2 c.c.). After shaking, the mixture was kept overnight. Dilution with water gave the *acetyl* derivative (1·7 g.; 82%). The compound crystallised from pyridine as colourless prisms, m.p. 307-09°. (Found: C, 75·6; H, 4·9. $C_{26}H_{21}NO_4$ requires C, 75·9; H, 5·1%.)

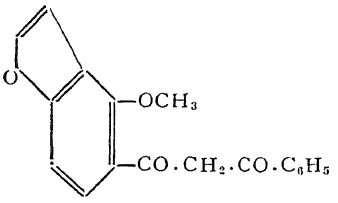
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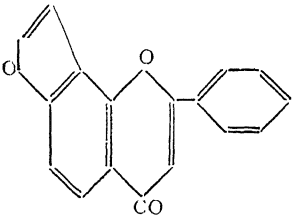
SYNTHESIS OF FURANO-(3′ : 2′ : 6 : 7)-FLAVONE

RECENT investigations have revealed the presence of furano-flavones and related compounds in the plant kingdom. For example, karanjin has been known to be the active principle of Pongamia oil,[1] while it accompanies pongapin, 3′ : 4′-methylene dioxy karanjin, in the root bark of *Pongamia pinnata* (L.) Merr.[2] from which two more furano-flavones of unknown constitution were isolated. Pongamol (I) from Pongamia oil[3] is unique as it is the only furano-diketone so far known to occur in nature. Further, from the root bark of *Tephrosia lanceolata* Grab., Rangaswami and Sastry[4] reported the isolation of three compounds, one of which was identified to be pongamol (I) and the other, the furano-flavone (II) derived from I. It is interesting to note that all these compounds possess only the angular structure.

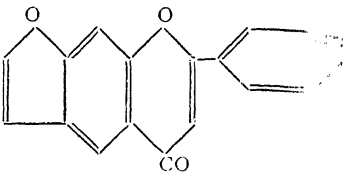
In connection with a synthetic programme of work on furano-pyrones[5] we had occasion to synthesise the isomeric linear furano-flavone (III) following the scheme given below,



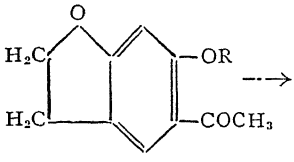
(I)



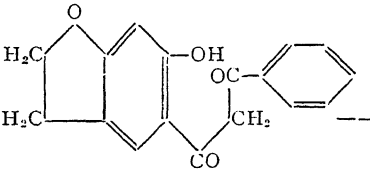
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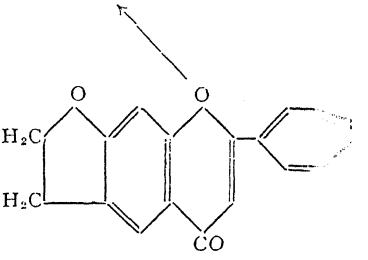
(III)



(IV)



(V)



(VI)

The benzoate (m.p. 113-14°; IV, R = CO.C_6H_5) of 5-acetyl-6-hydroxy coumaran[6] (IV, R = H) suffers migration when heated at 35-40° in presence of pyridine and potassium hydroxide for four hours. The resulting diketone (V) (m.p. 110-11°) crystallises from benzene-petroleum ether as bright yellow needles and gives a bright green ferric reaction. (Found: C, 72·2; H, 5·1; $C_{17}H_{14}O_4$ requires C, 72·4 and H, 5·0%.) When boiled with glacial acetic acid containing a few drops of concentrated hydrochloric acid, the diketone undergoes ring closure giving the dihydrofurano-(3′ : 2′ : 6 : 7)-flavone (VI). The latter crystallises from alcohol as pale yellow prismatic plates (m.p. 202-03°). It gives pale yellow solution in concentrated sulphuric acid with intense blue fluorescence. (Found: C, 77·0, H, 4·3; $C_{17}H_{12}O_3$ requires C, 77·3 and H, 4·5%.)

Dehydrogenation of the dihydro furano-flavone (VI) is effected by refluxing it in diphenyl ether with 30% Pd-C catalyst (Linstead's catalyst[7]). The furano-(3′ : 2′ : 6 : 7)-flavone (III) is obtained as pale yellow bundles of needles (m.p. 168-69°) from alcohol. (Found: C, 77·6; H, 4·1; $C_{17}H_{10}O_3$ requires C, 77·9 and H, 3·8%.) It exhibits only a yellow colouration with cold concentrated sulphuric acid which deepens when warmed in contrast to the angular furano-flavone (II) which gives a blue colour.[3]

S. K. Pavanaram.
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DIFFUSION WITH MULTIPLE ZONES OF INTERACTION

When unmasticated deproteinised rubber is in contact under static conditions with carbon tetrachloride in sealed tubes containing air and exposed to diffuse daylight, two sharp horizontal diffusion boundaries appear in accordance with the observations of Hartley.[1] On continued exposure these boundaries disappear when the mixture sets to a gel and becomes homogeneous.

It is the purpose of this note to record the occurrence of another phenomenon besides the one mentioned above. When these tubes are exposed to diffused daylight for a period exceeding 72 hours several rings are observed. These rings start from the boundary separating the concentrated solution from the rubber and are spaced more or less equidistant in the rubber phase. The last pair of rings in the rubber however are separated by a greater distance from the rest. These rings are shown in Fig.

The above rings persist in the gel even on continued exposure and are clearly visible

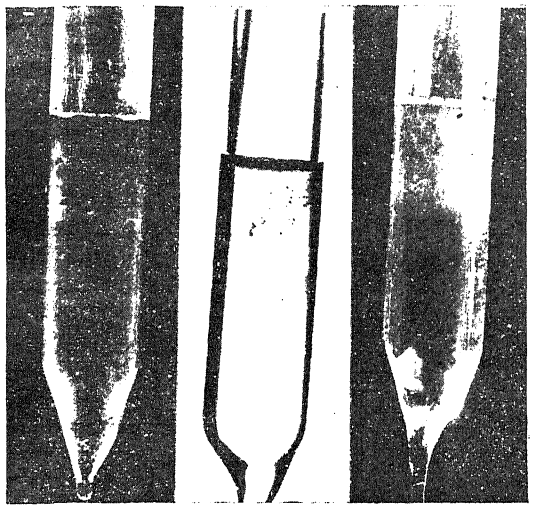


FIG. 1 FIG. 2 FIG. 3

the solid gel when it is pushed out of the tube. The appearance of these distinct rings indicates a change in the composition of the material in the narrow zones appearing as rings.

Hill[2] and Hermann[3] have discussed the displacement of an interaction boundary formed inside a polymer by the reaction of the diffusant with the substances found in the polymer. Recently Gordon[4] has also considered the interaction of a reagent with fixed reaction sites in a polymer.

The present investigation reveals the occurrence of multiple static rings when rubber-carbon tetrachloride systems are exposed to diffused daylight or to the action of X-rays (Fig. 2). These static rings do not appear when the system is kept in total darkness (Fig. 3).

From these results it is concluded that activated zones arise in rubber when subjected to irradiation and in these activated zones reaction between the polymer and the diffusant (CCl_4 or dissolved air) takes place. The diffusant is immobilized in the activated zones by the reaction giving rise to the observed rings. Further, these rings are in addition to ordinary diffusion boundaries and differ from them in that they do not disappear with time, whereas diffusion boundaries do so. Full details of the experiment will be published elsewhere.

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VITAMIN B_{12} AND RICE MOTH LARVAE

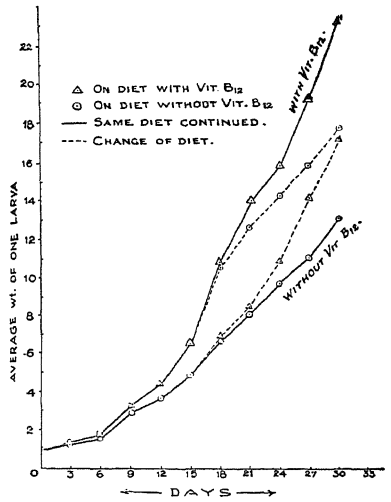
THE vitamin B_{12} requirement of animals and birds has been studied; but no data appear to be available about its requirement by insects. The rice moth larvæ (*Corcyra cephalonica* Staint.) shows a striking resemblance to the higher animals in their requirement of the B vitamins.[1-5] It is possible that they require vitamin B_{12} also for their normal growth. In this note is presented our work on the effect of vitamin B_{12} on the growth of rice moth larvæ.

The basal diet employed was soyabean meal used for the rats.[6] 25 g. of the ration containing corn soyabean meal, salts and vitamins was mixed with 1·0 g. of sesame oil and 0·25 g. of shark liver oil. This diet did not support the growth of *L. leichmanni* 313 and was taken to be deficient in vitamin B_{12}. The diet for the 'control' larvæ was prepared by adding a solution of 5 μg. of vitamin B_{12} to 25 g. of the deficient diet.

The eggs of the rice moth *Corcyra cephalonica* Staint. were obtained from the Entomologist to the Government of Mysore, South India. The larvæ hatched out of the eggs were maintained on a whole wheat flour for ten days and then used in the experiments.

In the preliminary experiments, two groups of ten larvæ each were used. They had nearly the same average weight at the start of the experiment. They were kept in separate glass petridishes, at the room temperature (27 to 28·5° C.) and the weights of the larvæ were recorded twice a week. It was observed that the larvæ maintained on corn-soyabean meal supplemented with vitamin B_{12} showed a better growth than those receiving the same diet without vitamin B_{12}. The experiment was repeated with two groups of twenty larvæ each. After 15 days the deficient larvæ were separated into 2 groups of approximately the same average weight and one group was transferred to the diet containing vitamin B_{12} while the other was continued on the same diet. Similarly the control larvæ were also separated into two groups one of which was transferred to the deficient diet and the other was continued on the same diet. The weights were recorded twice a week. The results represented in Graph I clearly indicate that the larvæ show a much better growth when fed the diet supplemented with vitamin B_{12} and the weight of larvæ shows a decrease when they are transferred to vitamin B_{12} deficient diet.

Beiler *et al.*[7] have reported the preparation of an 'antagonist of vitamin B_{12} by the oxidation of the vitamin with H_2O_2 in the presence of concentrated HCl. This substance has been found by them to have an inhibitory effect on the micro-organism *L. leichmanni*. The 'antagonist' is however reported to have no inhibitory effect on the gowth of rats.[8]



The effect of the 'vitamin B_{12} antagonist' was studied on the rice moth larvæ. The antagonist was prepared by the method of Beiler *et al.*[7] and mixed with the vitamin B_{12} deficient diet. The rice moth larvæ were fed this diet and the growth was compared with that obtained when they were maintained on the B_{12} deficient diet and the diet containing vitamin B_{12}. The results obtained indicate that the 'antagonist' does not probably have an inhibitory effect on the growth of rice moth larvæ. The larvæ fed antagonist show only a slightly better growth when fed the diet without vitamin B_{12}. A detailed account of this work will be published elsewhere.

We wish to express our thanks to the Trustees, Lady Tata Memorial Trust, Bombay, for the award of a Research Scholarship to one of us (R. V. B.).

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THE PROTEOLYTIC ACTIVITY OF RABBIT BRAIN THROMBOPLASTIN AND ITS INHIBITION BY HEPARIN

The exact mode of action of brain thromboplastin, which accelerates clotting of blood or plasma in presence of calcium, has not been established so far. The enzymic nature of thromboplastin had been suspected by many workers since it is known that brain thromboplastin preparations are still active when diluted to 10^{-5}. Seegers and Ware[1] have collected evidence to show that thromboplastin acts catalytically and is not consumed during the conversion of prothrombin to thrombin though Mertz, Seegers and Smith[2] had earlier reported that thromboplastin is consumed during blood coagulation. There has been indirect evidence in the literature to suggest the participation of proteolytic enzymes in blood coagulation. Eagle and Harris[3] and Ferguson[4] have found that trypsin, papain and other proteolytic enzymes could form thrombin from pro-thrombin. Macfarlane and Pilling[5] and Macfarlane[6] have shown that soya-bean trypsin inhibitor inhibits the action of brain thromboplastin.

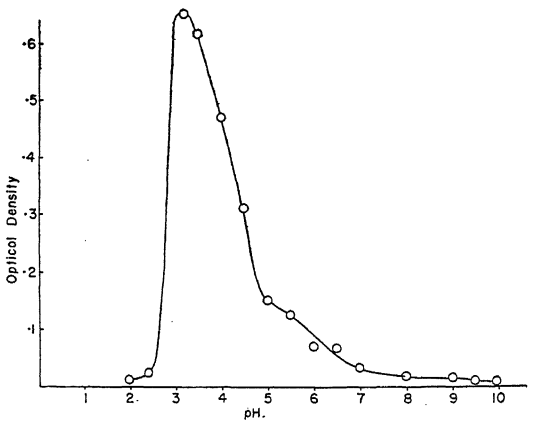


Fig. 1. Proteolytic activity of Rabbit Brain thromboplastin.

The proteolytic activity of a 0·5% rabbit brain thromboplastin suspension prepared according to Quick[7] was measured on heat denatured horse hæmoglobin substrate according to the method of Anson[8] at short intervals of

pH between 2 and 10 using Veronal-acetate-phosphate universal buffer. Fig. 1 shows that the optimum pH for the proteolytic action of thromboplastin is at about pH 3·2. It had hardly any activity at neutral or alkaline pH which probably explains the failure of earlier workers to detect its proteolytic activity. The proteolytic activity was completely destroyed on heating for 15 minutes at 100° C.

Heparin which inhibits blood coagulation was then tested to see whether it has any inhibitive action on proteolytic activity. It was found that purified heparin (100 units/mg.) inhibited the proteolytic activity of thromboplastin at pH 3·2. The inhibition was of a competitive type as judged from the results in Fig. 2. Details will be published elsewhere.

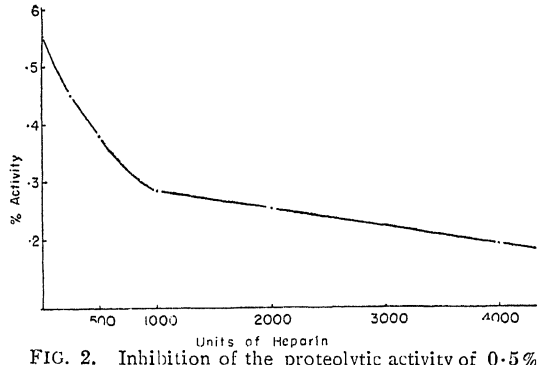


FIG. 2. Inhibition of the proteolytic activity of 0·5% Rabbit Brain thromboplastin with different concentrations of heparin.

The authors wish to thank Dr. P. M. Wagle and Dr. A. K. Hazra for their keen interest in the work. The authors are grateful to the Connaught Medical Research Laboratories, Toronto, for a generous gift of heparin, and to the Raptakos Medical Research Board for the award of a fellowship to Mrs. Rao.

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THE PARIETAL ORGAN IN *CALOTES VERSICOLOR* (DAUD.)

THE roof of the diencephalon of lizards is produced into median outgrowths namely, the paraphysis in front, the dorsal sac in the middle, the parietal organ (the pineal eye) and the epiphysis behind.[1] Recently it has been shown that the paraphysis is the centre of accumulation of neurosecretory products, coming from the hypothalamic centres, from where they diffuse into the blood stream.[2,3] The dorsal sac is a space continuous with the diacœl. The epiphysis is a glandular structure of endocrine function commonly known as the pineal body[4] and the parietal organ is generally attached to its anterior portion forming a vesicular structure lying in the parietal foramen or just below it.

According to Sedgwick,[5] the parietal organ in *Calotes* is stated to be quite separate from the brain unlike in many other lizards where it remains connected with the brain by a cord of tissue. In various sections of the brain of *Calotes versicolor* (Daud.) examined by me, it was seen that a cord of tissue is present connecting the parietal organ with the diencephalon (Fig. 1). This solid cord of tissue (Fig. 1, *c*) is bent and connected with the roof of the diencephalon just in front of the reduced and glandular epiphysis which forms a small hillock in the roof of the diencephalon. The vasicular parietal organ is ovoid measuring



FIG. 1. Sagittal section of the brain of *Calotes versicolor* (Daud.) to show the parietal organ and associated structures. Bouin and Gomori's chrome-hæmatoxylin-phloxin. The solid cord of tissue (*c*) connecting the parietal organ with the epiphysis (*e*) is distinctly seen. *n*, paraphysis, *P*, capillary plexus; *s*, dorsal sac; *w*, wall of parietal organ. Approximately, × 90.

about 650 μ in length with its walls composed of columnar cells with layers of nuclei. The organ is enveloped by a thick capillary plexus. The entire organ is separated from the paraphysis by a narrow space representing the dorsal sac.

A detailed study of the relations of the parietal organ, the neurosecretory centre of the paraphysis and the endocrine epiphysis is in progress.

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ENZYME COMPLEX OF THE CORPUS ALLATUM OF THE FEMALE *IPHITA LIMBATA* STAL.

A PRELIMINARY note on the structure and changes of the corpus allatum of the female plant bug *Iphita limbata* Stal. (Pyrrhocoridæ : Hemiptera) was published by the author.[1] No work has so far been done on the enzyme complex of the neurosecretory system of invertebrates.[2] The corpus allatum, which forms part of the pars intercerebralis-cardaicum-allatum system of the neurosecretory endocrine organs, shows marked changes in the secretory activity as the female starts mating and eggs begin to develop, reaching the maximum size as the insect becomes gravid. After oviposition the corpus allatum shrinks slowly.

This enlargement of the corpus allatum is also associated with an increase in the development of the enzyme content of the gland. Two enzymes, *viz.*, acid phosphatase and succinic dehydrogenase, gradually increase in amount as the corpus allatum enlarges. The maximum concentration occurs in the gravid female.

Gomori's technique as recommended in his recent book[3] has been employed for the study of acid phosphatase, control material being inactivated by either Lugol's iodine or boiling water. Incubation for six hours at 37° C. gave the best results. Seligman and Rutenberg's[4] method using blue tetrazolium and Shelton and Schneider's (Pearse[5]) method using neotetrazolium were used for the study of succinic dehydrogenase, control material being incubated with sodium malonate added to the mixture. Freshly dissected corpora allata have been used in the studies.

In the newly moulted female imago, the corpus allatum shows the nuclei as seats of acid phosphatase. In that of the female which is mating and where eggs are developing, besides the nuclei there are granules indicating sites of acid phosphatase in the cytoplasm. In the gravid female, the black granular material is distributed in the cytoplasm in large quantities, showing a high concentration of the enzyme. After oviposition, the enzyme content of the gland remains practically the same (Fig. 1).

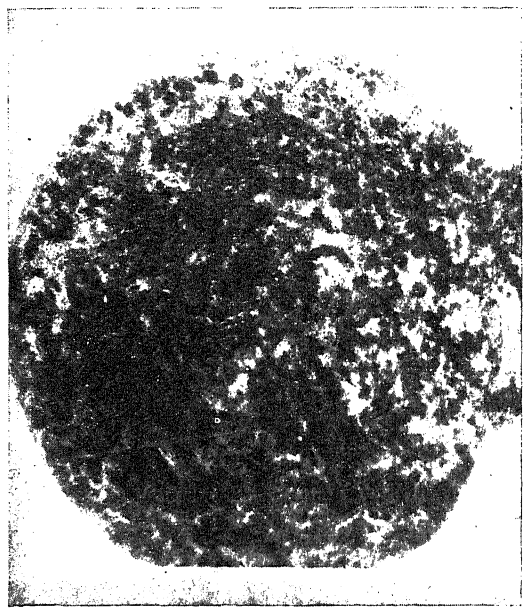


FIG. 1. Corpus allatum of the female *Iphita limbata* Stal., twelve hours after oviposition, to show the sites of acid phosphatase activity. The dark rounded bodies are the nuclei, the black patchy regions and granules are localisations of the enzyme in the cytoplasm. Incubation time 370 minutes. Approximately, × 75.

Newly emerged imagines show practically no positive indication of succinic dehydrogenase in the corpus allatum. But in the mating female where the corpus allatum is enlarging, well-defined particles indicating sites of succinic dehydrogenase activity make their appearance. A large number of blue diformazan particles and few monoformazan granules occur in the cytoplasm, especially along the margin of the gland and near the allatic nerve. In the gravid female, with highly distended abdomen and mature eggs, the cytoplasm shows very high concentrations of the enzyme, demonstrable by both the methods. There are

myriads of blue (or purple in Shelton and Schneider's method) granules in the cytoplasm and where the entire gland is incubated, concretions of these granules occur as large and conspicuous colloids (Fig. 2). The nuclei appear

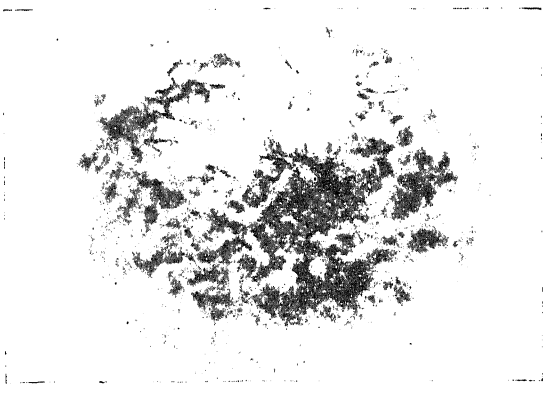


FIG. 2. Corpus allatum of the gravid female, showing sites of succinic dehydrogenase activity. Shelton and Schneider's method. Incubation time 40 minutes. The colour developed in three minutes. Approximately, ×55.

as transparent vesicles. There is a marked fall in the enzyme content as oviposition occurs.

More detailed investigations on the cyclical development of the enzymes in the corpus allatum and the relationship between the dehydrogenase system and the oxidases in the blood of the female, are in progress.

I am indebted to Prof. C. M. Francis, Medical College, Trivandrum, for the gift of tetrazolium used in this study.

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THE CERVICAL EXTENSIONS OF THE THYMUS IN *LORIS LYDEKKERIANUS* (CABR.) AND THEIR SIGNIFICANCE

LORISOIDS exhibit a number of primitive features of anatomy. Some authors[6,7] consider them as truly primitive, while others[1,3,1] regard them as secondary simplifications consequent on sedentary habit. While examining the thymus of *Loris lydekkerianus*, it was discovered that in the embryo of this prosimian, the thymus extended into the cervical region and was lymphoidal, thus offering a condition which must be regarded as primitive.

The thymus of *Loris lydekkerianus* is well developed in the fœtus and also in young individuals. It consists, on each side, of a main part, located in the thorax, which gives off anteriorly, a cervical extension reaching up to the thyroid gland. This extension is made up of 5-6 distinct lobes. Each lobe is lymphoidal in nature, is enclosed by a thin compact capsular wall and shows a clear demarcation between cortex and medulla (Fig. 1). The cortex is

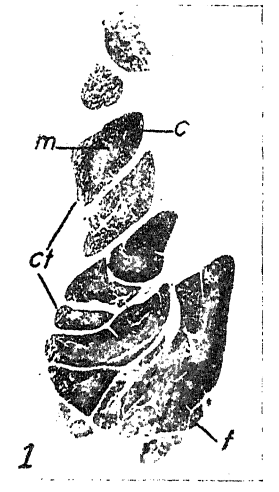


FIG. 1. Sagittal section of the thymus of *Loris* embryo (CR length=30 mm.) showing its lobulated lymphoidal cervical extension, × 11. *c*=Cortex ; *ct*=Cervical thymus ; *m*=Medulla; *t*=Thoracic thymus.

made of thymocytes, while the medulla consists of reticular cells, thymocytes, basophilic granulocytes and simple plasmodial Hassall's corpuscles.

The lymphoidal nature of the cervical thymus in *Loris lydekkerianus* has great significance. In a higher mammal like *Loris* it is an indication of the persistence of a primitive character. It is well known that in lower vertebrates[2,8,9] the thymus is lymphoidal in embryonic and larval conditions and is jugular in position. But in mammals, due to elongation of the cervical region, the main portion of the thymus migrates to the thorax leaving remnants of thymic tissue in the cervical region. Generally this cervical portion is a simple epithelial cord and is not lymphoidal in nature (except in ungulates[10]) and disappears very early.[4,5] The persistence of a well developed lymphoidal cervical thymus in *Loris lydekkerianus* embryo and young is indicative of a

truly primitive condition which we believe is primary and not due to a secondary simplification. Besides, the non-hyalinized Hassall's corpuscles of *Loris lydekkerianus* recall rather the multinucleated plasmodial masses of the reptilian thymus[9] than the hyalinized corpuscles of Hassall of either guinea-pig or man, offering yet another feature of the primitive organization of the thymus in this form.

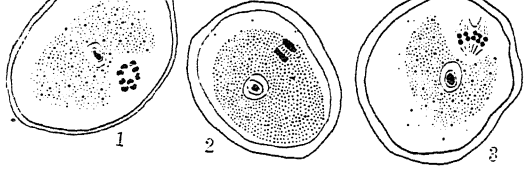
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CHROMOSOMES IN OOGENESIS OF *ASCARIS VITULORUM*

PERHAPS no other species has received the attention of cytologists as much as *Ascaris megalocephala* (*Parascaris equorum*) has done. Two recent papers by Lin[2] and Fauré-Fremiet[1] have shed considerable light on some cytological problems which had till now been obscure. Other species in the family, however, have not received the same attention and a very common parasite in Indian cattle, *Ascaris vitulorum*, has found no place in cytological literature. Makino[3] makes no mention of the chromosomes of this species in his Atlas. And no account of gametogenesis, fertilization or the striking phenomena so characteristic of cleavage divisions in *Parascaris equorum* have been described or looked for. It is with the idea of extending our knowledge of members of Ascaridæ that this study was undertaken.



FIGS. 1–3. Fig. 1. Oocyte of *Ascaris vitulorum* showing the polar view of first metaphase. Nine bivalents are seen. The sperm nucleus is in the centre, × 315. Fig. 2. Oocyte in first anaphase. Side view, × 315. Fig. 3. Oocyte showing a tripolar spindle. First division, × 315.

Fertilization occurs as in *Parascaris equorum* while the nucleus of the oocyte is in the germinal vesicle condition and only after the entry of the sperm the nucleus completes its divisions and the two polar bodies are extruded. Nine bivalents are noticed in metaphase of the first division. Soon the division is complete and the first polar body is cast out. The second division follows soon after and though they are much smaller, there is no difficulty in making out the nine chromosomes. The sperm nucleus, which till now is a deeply staining quiescent body lying in the centre of the oocyte cytoplasm, slowly enlarges and becomes irregular in outline as the second meiotic division goes under way. The cleavage divisions have not yet been examined thoroughly and will be described in a separate communication.

Multipolar spindles are quite common in the first meiotic division and while it is difficult to account for them, it seems reasonably certain that they ultimately degenerate.

Grateful thanks are due to Dr. N. Krishnaswamy of the Agricultural Research Station, Coimbatore, for the gift of this material and to Dr. B. R. Seshachar for guidance and encouragement.

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ON THE BONY-PALATE OF THE INDIAN HAWK, *FALCO JUGGER* (GRAY)

HUXLEY[2] based his classification of birds on the disposition of the various bones of the palate. He grouped vultures, hawks, and eagles along with other Raptores diurnæ as Gypætidæ, a sub-group of Aetomorphæ, which is equivalent to the "Raptores" of Cuvier. The disposition of the palatal constituents of the Indian hawk has undergone a modification different from that in other birds of the group. I have, therefore, ventured to study the bony-palate of *Falco jugger* (Gray) in detail.

The maxillo-palatine apparatus formed by the union of the paired, oblong, plate-like

maxillo-palatines contributes to the formation of the anterior part of the palate. The maxillo-palatines are fully ossified and meet in the middle line thereby completely obliterating the intervening space, a contrast to similar spongy and narrow structures, reported in other Raptores diurnæ.[2]

The elongated palatines are paired and spatulate in shape. They form the greater portion of the palatal roof of the mouth and border the choanæ or inner narial openings. Their posterior parts or "bodies" are boat-like in shape and are transversely expanded. Anteriorly the bodies of palatines pass into narrow "ascending processes". The inner margins of the upper half of these processes abut against the maxillo-palatine of the corresponding side.

The posterior end of the palatine and the anterior end of the pterygoid, besides articulating with one another articulate with a small, distinct, triangular bone, the basipterygoid which has, hitherto, been unrecorded in Gypætidæ. This bone may be compared to the so-called "mesopterygoid" of Parker[3] and the "hemipterygoid" of Pycraft.[4]

The pterygoids are rod-like structures obliquely directed towards the ventral head of quadrate, the condylus mandibularis. In contrast to what is generally met with in most desmognathous skulls, the anterior ends of the pterygoids and the posterior ends of the palatines do not articulate directly with the basisphenoidal rostrum, but through the basipterygoids which, though sessile, have fibrous connections with the basisphenoidal rostrum. In a few other cases Broom[1] has noted cartilaginous connections also.

The basisphenoidal rostrum lies between the pterygoids. Anteriorly it is narrow and its posterior end along with the anterior end of the basisphenoid forms a transversely directed ridge.

Intervening between the two palatines there is a narrow parasphenoid (basitemporal of Parker). It takes part in the formation of a cartilaginous-*cum*-bony orbital septum. It is interesting to note that the parasphenoid and vomer are quite distinct bones. The presence of the two distinct bones is a primitive feature. The vomer has been recorded as being completely absent or vestigial in desmognathous skulls.[2] But it has been observed as a prominent slender bone extending from the posterior margin of the maxillo-palatine shelf to the anterior margin of the parasphenoid. The vomer typically extends between the internal nostrils and forms their postero-medial boundary. In contradistinction to Huxley's observation, in the forms where it exists, the vomer is not tapering but ends bluntly at both the ends.

Thus an osteocranic maxillo-palatine, together with a small basipterygoid, a separate vomer and parasphenoid are features in which *Falco jugger* (Gray) has specialised, and from a comparative standpoint, in its palatal structure it is different from other members of its group. A unique factor to be noted in this case is the tendency towards retention of the more primitive cranial characters.

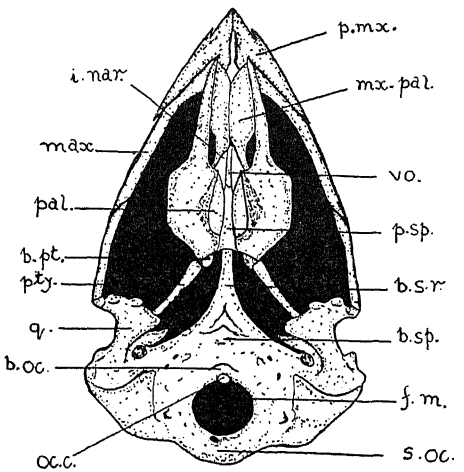


FIG. 1. Ventral view of the skull of *Falco jugger* (Gray) showing the bony-palate, × 1. *b.oc.* = basioccipital; *b.pt.* = basipterygoid; *b.sp.* = basisphenoid; *b.sr.* = basisphenoidal rostrum; *f.m.* = foramen magnum; *i.nar.* = internal nare; *max.* = maxilla; *mx.pal.* = maxillo-palatine; *Oc.c.* = Occipital condyle; *pal.* = palatine; *p.mx.* = premaxilla, *p.sp.* = parasphenoid; *pty.* = pterygoid; *q.* = quadrate; *S.Oc.* = Supraoccipital; *Vo.* = Vomer.

A detailed paper on the cranial morphology of this bird will be published shortly.

I am thankful to Dr. P. N. Mathur for his kind guidance and supervision and to Principal V. V. John for research facilities and to Sri. Jagdish Prasad for his helpful criticism.

Dept. of Zoology, V. D. MATHUR.
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FUSARIUM WILTS OF WATERMELON AND PEAS IN BOMBAY STATE

Wilt of Watermelon.—A wilt disease of watermelon (*Citrullus vulgaris* Schrad.) causing serious damage was recorded in January 1955 at Dorli near Kalyan in Thana District. Roots of affected plants showed the characteristic browning of vascular system and a microscopic examination showed presence of fungus hyphæ in the xylem vessels. A species of *Fusarium* was consistently isolated from roots of diseased vines and the fungus proved pathogenic to watermelon (local variety) in inoculation experiments at Poona. Isolates of the fungus from artificially inoculated plants were indistinguishable from the original cultures. This is the first time that a *Fusarium* wilt of watermelon has been recorded in India.

The fungus is indistinguishable from *Fusarium oxysporum* f. *niveum* (E.F.S.) Snyder and Hansen causing watermelon wilt in the U.S.A. and Europe.

Wilt of Peas.—A destructive wilt disease of garden peas (*Pisum sativum* L.) was recorded at Wai and Mahableshwar in North Satara District in November 1952 where garden peas is an important cash crop. The disease is now common in Poona District also and causes serious damage. A species of *Fusarium* was isolated from wilted pea vines in December 1952 and proved pathogenic to pea in infection experiments carried out at Poona. A detailed study of the fungus showed that it was indistinguishable from *Fusarium oxysporum* f. *pisi* (Linford) Synder and Hansen, race 1, causing wilt of peas in the U.S.A.

The following commercial varieties of peas resistant to wilt were obtained from the U.S.A. and Holland and tested at Poona is a glasshouse against the fungus causing wilt of peas in Bombay State: Alaska, Wisconsin Perfection, Pride, Perfected Wales and New Era from U.S.A. and Alaska, Celsior, Korza, Vares and Zelka from Holland. All these varieties proved susceptible to the Bombay strain of the fungus. It is, therefore, possible that the Bombay fungus is a biotype of the American pea wilt fungus, though conclusive evidence has not yet been obtained. More work on this problem is in progress at Poona.

Plant Pathological Lab., V. P. BHIDE.
College of Agriculture, R. K. HEGDE.
Poona-5, *April* 19, 1953. R. S. SUKAPURE.

ANTIBIOTIC PRODUCTION BY *FUSARIUM VASINFECTUM* ATK. IN SOIL

EVIDENCE indicating antibiotic production in soils, has so far been presented only in the case of non-pathogenic soil fungi.[1–4] The present note reports production of an antibiotic in soil by a plant pathogenic soil fungus, *viz.*, *Fusarium vasinfectum* Atk. Earlier work[5,6] has already shown that this fungus produces fusaric acid, a phytotoxin, also capable of antibiosis, *in vitro*.

The soil (pH 8·1 and moisture-holding capacity 47·5%) used was collected from the Madras University Botany Field Laboratory Garden. 90 g. of sieved soil taken in 250 ml. Erlenmeyer flasks were given 10 g. of the following amendments: glucose, filter-paper, stubbles of cotton plants (*Gossypium arboreum*), green leaf choppings (*Glyricidia maculata*), farmyard manure and oats. Distilled water was added to each flask to keep the moisture level at 60%. After sterilisation at 20 lb. steam pressure for an hour and a half, the flasks were inoculated with spore suspensions of *F. vasinfectum* and incubated at room temperature (28-32° C.). The uninoculated series served as control. At regular intervals, cultures in replicates of four were removed with minimum amount of distilled water and centrifuged at 3,000 r.p.m. for 45 minutes.[3] The extracts thus obtained were tested for final pH before assaying for antibiotic potency in terms of fusaric acid equivalent.[6]

TABLE I

Production of antibiotic (expressed as μg. fusaric acid equivalent/g. of soil) in sterilised soil with different amendments

Age in days	None	Glucose	Filter paper	Stubbles	Farmyard manure	Green leaf	Oats
7	nil	nil	nil	nil	nil	nil	1·25
14	nil	nil	nil	traces	nil	2·30	7·90
21	nil	nil	nil	nil	nil	2·90	2·19
28	nil	nil	nil	nil	nil	2·60	2·00

The results in Table I indicate that *F. vasinfectum* produces this antibiotic in sterilised and amended soil (+ green leaf and oats), the maximum quantity produced (7·9 μg./g.) being in the presence of oats. There seems to be no detectable quantities of

this antibiotic in soil with any of the other amendments tried except for traces on the 14th day in stubble amendment. In both oat and green leaf amended soils there was a drift to the acid side from the original pH of 8·1.

Unlike *Aspergillus terreus, A. clavatus* and *Penicillium patulum* which were shown by Grossbard[3] to produce antibiotics in soils supplemented with glucose alone, *F. vasinfectum*, as evident from these results, requires ample source of both organic nitrogen and carbohydrate for the production of fusaric acid in soil. In fact, it is worthwhile to note that *P. patulum* produced decreasing quantities of antibiotic with increasing concentration of nitrogen.[3]

The significance of the production of this antibiotic by *F. vasinfectum* in sterilised soil amended with rich source of organic food, especially in the light of increasing knowledge of microbial activity in the rhizosphere[7,8] has been discussed elsewhere.[9]

The author is thankful to Prof. T. S. Sadasivan and Dr. C. V. Subramanian for valuable suggestions in the preparation of this paper and the Government of India for the award of a Fellowship.

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Madras-5, *June* 23, 1955.

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OBSERVATIONS ON NUCLEAR PHENOMENON OF SPORE-GERMINATION IN THE MYCELIA OF *POLYSTICTUS SANGUINEUS* (L.) MEY.

AN investigation into the nuclear conditions in the mature spores of *Polystictus sanguineus* (L.) Mey. before and after germination and also in the monocaryotic as well as dicaryotic mycelia has been made. This has been done from total preparations of spore-deposits and cultures upon thin films of agar on slides prepared according to Kniep's method as modified by Sass.[1]

The observations show that the mature spores are always uninucleate (Fig. 1, *a*). When

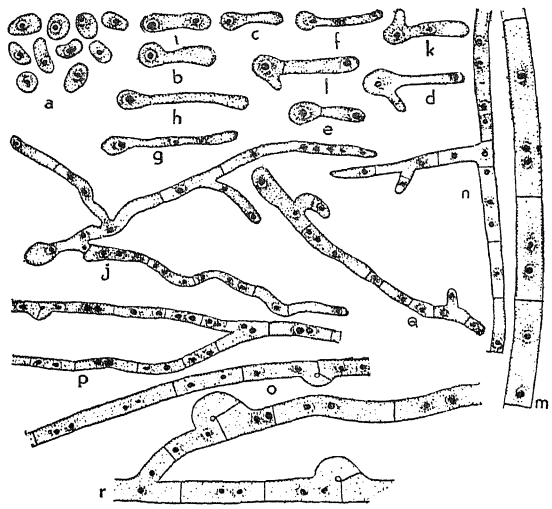


FIG. 1. Nuclear Phenomenon of Spore-Germination in the Mycelia of *Polystictus sanguineus* (×685).

germination starts a short germ-tube is produced (Fig. 1, *b* and *c*). This is followed by the division of the spore-nucleus. One of the two daughter nuclei thus produced then migrates into the germ-tube while its sister nucleus remains within the spore-case (Fig. 1, *i*). As the germ-tube elongates a transverse septum develops usually towards its base close to the point of its emergence from the spore-case (Fig. 1, *e*). This septum-formation may sometimes be postponed until the nucleus within the spore-case has divided further (Fig. 1, *f* and *g*). The aseptate germ-tube, in such cases, may attain a length of 20 μ (Fig. 1, *g*). The resulting primary mycelium has most of its constituent cells multinucleate, each with 2-6 nuclei (Fig. 1, *j*). In preparations of monocaryotic mycelia obtained from cultures similar coenocytic conditions have also been found in certain cells (Fig. 1, *n*). It is, therefore, evident that nuclear divisions are not always followed in regular sequence by the division of the cells by the formation of septa. In some cases two successive germ-tubes are produced from different places of the spore-wall, but the second one generally develops almost at right angle to the first (Fig. 1, *k*). In such cases the second germ-tube makes its appearance only after one of the daughter nuclei of the spore has migrated into the first germ-tube (Fig. 1, *k*). The remaining daughter nucleus within the spore-case then divides and one of these daughter nuclei passes into the second

germ-tube (Fig. 1, *d*). The formation of a septum at the base of the first germ-tube usually occurs before the development of the second germ-tube (Fig. 1, *e*) or before the migration of a nucleus into the latter (Fig. 1, *l*), but it may also be further delayed.

In the stained preparation of a dicaryotic mycelium the nuclei, in some cases, seem practically to occupy the entire width of the hyphal cells (Fig. 1, *p*). The hyphal cells are usually dicaryotic in the sense that they have a paired condition of nuclei, although 3-4 nucleate cells are not altogether uncommon (Fig. 1, *l*, *m*, *o*, *p*, *r*). The clamp-connections are not very frequent in their occurrence. Therefore, the same hypha may have septa with or without clamp-connections (Fig. 1, *o*, *p* and *r*). The nucleus in all cases can be seen as a deeply stained chromatin-body often surrounded by a hyaline zone separating it from the nuclear membrane.

Dept. of Botany, SACHINDRANATH BANERJEE.
Calcutta University, ASOKE KUMAR SINHA.
Calcutta-19,
March 29, 1955.

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A NEW *PHYLLACTINIA* FROM MADHYA BHARAT

WHILE on a visit to Sukhanand Temple which lies 5 miles north of the Town of Jawad (24° 36′ N., and 74° 52′ E.) in the Mandsaur District of Madhya Bharat, the writer collected a *Phyllactinia* in cleistothecial stage on the fallen leaves of *Cordia dichotoma* Forst. In establishing it as a new species the author is closely following the treatment of the genus as advocated by Blumer,[1] Linder,[2] and Doidge.[3]

In Table I the present species has been compared with others possessing larger cleistothecia. The dimensions of cleistothecia, asci, and ascospores of *P. salmoni* Blumer, *P. hippophäes* Thuem., *P. robonis* (Gachet.) Blumer, *P. suffulta* (Rebent.) Sacc., and *P. elœgni* Linder are taken from Linder,[2] while those of *P. combreti* Doidge from Doidge.[3] It is a pleasure to dedicate this species to Dr. M. J. Thirumalachar whose contributions to Systematic Mycology in India are so vast and varied.

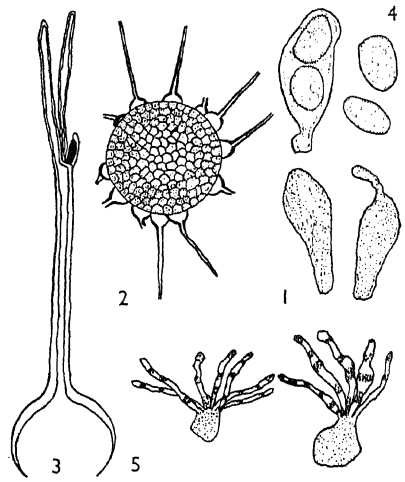


FIG. 1. Two conidia, one germinating at its apex, × 253. FIG. 2. A cleistothecium in surface view, ×60. FIG. 3. An appendage proliferating into four branches (one darkened in the figure), × 327. FIG. 4. An ascus and two released ascospores, × 208. FIG. 5. Two separated penicillate cells, × 327.

Phyllactinia thirumalachari Payak spec. nov. *Mycelium* hypophyllum, operiens totam laminam, persistens, pallide album. *Conidia* (Fig. 1) acrogena, solitaria, rhomboidea vel lanceolata vel subclavata, hyalina, irregulariter atque dense verrucosa, 49·4-83·6 × 15·2-26·6 μ. *Cleistothecia* (Fig. 2) hypophylla numerosa, dispersa, raro gregaria, brunneo-nigra, sphærica, 190-342 μ diam. *Appendices* (Fig. 3) 20-25 in

TABLE I

Species	Cleistothecia		Asci		Ascospores
	No. of appendages	Diameter in microns	No. of Asci	Size in microns	Size in microns
P. salmoni	10–30	294–362	20–30	80–110×30–50	35–45×20
P. hippophäes	Many	246–275	25–40	70– 80×25–40	20–35×15–20
P. robonis	15–30	214–250	15–30	70– 90×25–35	30–40×19–23
P. suffulta	6–12	160–230	10–30	70–100×25–50	25–40×15–25
P. elœgni	8–13	247–303	30–35	97–110×34–42	38–47×19–23
P. combreti	15–20	275–400	40–50	80– 95×27·5–37·5	35–40×17·5–25
P. thirumalachari	20–25	190–342	25–35	68– 95×27–34	23–42×17–23

singulis cleistotheciis, æquatoriales, bulbosæ ad basim, fastigatæ vel rotundatæ ad apicem, centro hyalino, rigidæ, nonnumquam binæ ex unica basi, vel proliferantes in duos tresve ramos prope apicem, breviores diametro cleistothecii vel ei æquales, 220-342 μ longæ. *Asci* (Fig. 4) 25-35 un singulis cleistotheciis, luteo-aurantiaci, subcylindrici vel late clavati, acute desinentes in uncum vel paxillum ad basim, nonnumquam apicilater crassi, magnit. 68-95 × 27-34 μ. *Ascosporœ* (Fig. 4) ovato-ellipticæ vel angulariter globoideæ ob mutuam pressionem, aurantiacæ, parietibus lævibus, binæ vel quaternæ in singulis ascis, magnit. 23-42 × 15-23 μ. *Cellulæ Penicillatœ* (Fig. 5) plurimæ, bene evolutæ, *plus* minusve persistentes.

Habitat in foliis deciduis *Cordiæ dichotomæ* Forst. in loco Sukhanand, proper Jawad, in Distr. Mandsaur, in Statu Madhya Bharat, die 5 martii, 1953; typus lectus a M. M. Payak.

The type is being deposited in the Herb. Crypt. Indiæ Orient., New Delhi, Herbarium of the Commonwealth Mycological Institute, Kew, U.S. National Fungus Collection, and Farlow Herbarium of the Harvard University.

I am indebted to Dr. S. P. Agharkar for his interest and encouragement, to Rev. Father H. Santapau, S.J., for furnishing the Latin diagnosis and finally to Dr. M. J. Thirumalachar for his invaluable help and advice.

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* Junior Research Fellow of the National Institute of Sciences of India.

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OCCURRENCE OF *SERRATIA MARCESCENS* BIZIO ON CUTWORM FROM INDIA

The "prodigious" or "miraculous" bacterium *Serratia marcescens* Bizio (Syn. *Chromobacterium prodigiosum* Topley and Wilson, *Bacterium prodigiosum* Lehmann and Neumann) has not yet been reported to occur in India. In the course of investigations on control of insects by microbiological methods, a bacterium was isolated from *Agrotis Ypsilon* (cutworm insect commonly occurring in West Bengal on cabbage, potato, cauliflower, etc.). The pure culture of the bacterium was made on nutrient agar and it was identified as *Serratia marcescens* Bizio. As the bacterium is being reported for the first time in India and as considerable variation exists in the species a short description of the organism isolated is given below:

Morphological Characters.—Single to chained cells, spherical, measuring 0·4 to 0·8 μ rigid, polymorphism reported by Reed[1] was not noted. The organism is gram negative, motile with peritrichous flagella, non-capsulated, non-spore-forming, aerobic to facultative. The organism is usually deep red in colour due to presence of a pigment prodigiosin.[2]

Cultural Characteristics.—On nutrient agar, colonies are mostly smooth (99% smooth, 1% rugose), circular, raised, entire, undulate to lobate, red to shiny pink. Pigmentation starts at the very initiation of growth and within 24 hours the colonies have the characteristic red to shiny pink colour. On plating out, the red colonies usually give rise to a few white colonies. The white ones tend to remain white in subsequent generations.

On nutrient agar slants, 24 hr.-old culture shows moderately heavy growth. Growth is smooth, with moist layer, filiform with tendency to become echinulate.

In nutrient broth, 48 hr. growth shows the presence of red ring with deposition of red sediment. Pellicle formation is absent. Motility is noticed in young as well as one week-old culture.

The organism fails to grow on a medium containing 1% glucose, 0·2% sodium nitrate, 0·5% potassium dihydrogen phosphate and 0·2% magnesium sulphate, but when sodium nitrate is replaced by ammonium salts, moderate growth takes place, but pigmentation is usually lacking.

On sterilized potato cylinders, growth is moderate at the beginning, but within 72 hours it becomes heavy. Pigment formation is intense and the pigment formed is deep red to dark, the potato cylinders however remaining colourless.

Biochemical Characters.—Gelatin liquefied within 3-5 days; Litmus milk—acid formation followed by curdling, casein completely digested and pigment formed in the milk; H_2S—not liberated; Reduction of nitrate—satisfactory in 2% peptone broth containing KNO_3; NH_3—formed; Utilisation of carbon sources—acid, but no gas is produced in glucose, lactose, sucrose, mannose and glycerol.

Pigment formation is found to be dependent on presence of organic nitrogen in the medium and suitable temperature and takes place between 24° C. and 36° C., the optimum temperature being 28-30° C. The pigment sometimes,

in the initial stages, is light in colour but becomes deep with age. In this case it was found to be soluble in water, alcohol and benzol. Bergey[3] reports that the pigment is soluble in water in cases of deeply pigmented strains.

It may be pointed out that Dixit and Vachha[4] reported a few years back a species of *Serratia Sambharianus* from Sambhar Lake, India, which is entirely different from *Serratia marcescens* Bizio.

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INHERITANCE OF WAXY BLOOM IN WHEAT PLANTS

ONE of the items of plant breeding work undertaken at the Agricultural Research Station at Bijapur in the Bombay State is the hybridization of high yielding selections in the local durum wheats with the Canadian rust-resistant type 'Gaza'. The selections, which mature in about 96 days as against the 118 days required by 'Gaza' under Bijapur conditions, develop bloom on their stem and leaves in about the fifth week, 'Gaza' being wax-free.

Wax-efflorescence has been studied by several workers who have found it either dominant or recessive.[1-3]

Two crosses were made by the authors in 1949-50, and the results obtained are reported here. In both crosses the F_1 plants were found to be wax-free. The wax-less and waxed individuals in the F_2 generation were 191 and 63 respectively in the cross Gaza × 485-56 Red Hard, and 77 and 31 in Gaza × 39-1 Yellow-grained. In both cases the fit to the 3 : 1 ratio of monogenic inheritance was very good, the X^2 being 0·005 and 0·790 respectively with P values between 0·95 and 0·50 in the first case, and between 0·50 and 0·20 in the second case.

The seed of the F_2 individuals was sown to raise the third generation of the crosses with a view to separate out the segregating and non-segregating progenies. The data are presented in Table I.

The 59 : 122 : 47 and the 19 : 55 : 34 ratios of the progenies of the first and second cross respectively are comparable to the behaviour expected of an F_3 segregation. Examination of a still larger number of progenies would perhaps give a better estimate of the homozygous classes in the F_3 generation as, for instance, the progenies of the two crosses added together indicate a 78 : 177 : 81 ratio fitting closely to the expected one, *viz.*, 84 : 168 : 84 for the three classes of frequencies (X^2—1·02; P—0·99).

TABLE I

Name of the Cross	No. of F_3 progenies with wax-less plants only	No. of F_3 progenies segregating for wax-less and waxed plants in a monogenic manner	No. of F_3 progenies having waxed plants only	Total No. of progenies studied in F_3 generation
Gaza × No. 485-56	59	122	47	228
Expected on a 1 : 2 : 1 basis	57	114	57	228
	χ^2-2·39; P between 0·50-0·20			
Gaza × No. 39-1	19	55	34	108
Expected on a 1 : 2 : 1 basis	27	54	27	108
	χ^2-4·2; P between 0·20-0·10			

The waxy bloom as studied in the durum crosses is therefore recessive to the wax-free plants, the two characters being governed by a single factor pair.

Agric. Res. Station, V. M. CHAVAN.
Bijapur, G. P. ARGIKAR.
February 12, 1955. P. S. HATTIANGADI.
M. S. SALANKI.

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EFFECT OF S/Se AND Ca/B RATIOS ON GROWTH AND SAP CHARACTERISTICS OF SUGARCANE

AN attempt is made in this note to illustrate the possible variation in growth and sap characteristics of sugarcane (var. Co. 453) when grown under varying ratios of S/Se and Ca/B in local sandy loam soils. Different ratios under study were: (*i*) S/Se—10 : 10; 9 : 6; 15 : 5; 15 : 2·5 and 12 : 1; and (*ii*) Ca/B—10 : 2·5; 20 : 2; 30 : 1·5; 40 : 1; and 50 : 0·5. Quantity supplied was expressed in p.p.m. of soil.

A basal nutrition of 80 p.p.m. N, 40 p.p.m. P_2O_5 and 20 p.p.m. K_2O was also supplied as sulphate of ammonia, superphosphate and sul-

phate of potash. Treatments were replicated four times. Analysis of growth and sap characters was done in the manner described earlier.[1]

S/Se ratios showed significant responses on various sap characteristics. A ratio of 3 : 1 appeared desirable for leaf weight, yield and height. Higher ratio of 12 : 1 improved root weight and leaf number. A ratio of 3 : 1 raised density and osmotic pressure of the stem sap. Osmotic pressure, solute concentration and electrical potential of leaf sap were also improved. A higher ratio of 6 : 1 induced marked improvement in surface tension, specific electrical conductivity and pH of stem sap. A ratio of 12 : 1 raised viscosity of the stem sap besides improving density, surface tension, viscosity and pH of the leaf sap. Harmful effect of Se on yield was overcome by supplying in a S/Se ratio of 3 : 1 while higher doses of sulphur in the ratio of 6 : 1 or 12 : 1 improved physico-chemical properties of the sugarcane sap. Such improvements in growth were also recorded in these and other species of plants[3,4] under certain specific ratios of these elements.

TABLE I

Optimum ratios of S/Se and Ca/B for various growth and sap characteristics of sugarcane

Characters	Optimum S/Se ratio		Optimum Ca/B ratio	
	Stem	Leaf	Stem	Leaf
A. Growth Characters				
Shoot number	3·0		100·0	
Leaf number	12·0		4·0	
Shoot height (cm.)	3·0		20·0	
Leaf weight (g.)	1·5		4·0	
Trash weight (g.)	6·0		20·0	
Root weight (g.)	12·0		20·0	
Cane weight (g.)	3·0		20·0	
B. Physico-chemical Properties of Sap				
Density	3·0	12·0	100·0	10·0
Surface tension	6·0	12·0	4·0	20·0
Viscosity	12·0	1·0	4·0	100·0
Osmotic pressure	3·0	3·0	100·0	4·0
Solute concentration	1·0	3·0	4·0	10·0
Electrical resistance	1·5	12·0	4·0	40·0
Sp. electrical conductivity	6·0	1·0	100·0	10·0
pH	6·0	12·0	10·0	20·0
Electrical potential	1·5	3·0	4·0	4·0

Taking height, trash, root and cane weight into consideration a Ca/B ratio of 20 : 1 appeared most desirable. A lower ratio of 4 : 1 appeared favourable for leaf number and weight, while tillering was maximum under 100 : 1 ratio. Surface tension, viscosity, solute concentration, electrical resistance and electrical potential of leaf sap were improved under Ca/B ratio of 4 : 1. A higher ratio of 10 : 1 appeared desirable for maintaining high pH. Even 100 : 1 ratio appeared favourable for density, osmotic pressure and specific electrical conductivity of stem sap.

On leaf sap a Ca/B ratio of 4 : 1 again improved osmotic pressure and electrical potential, while density, solute concentration and specific electrical conductivity were higher under 10 : 1 ratio. A ratio of 20 : 1 improved surface tension and pH, while 100 : 1 raised the viscosity of the leaf sap (Table I). Calcium was, therefore, invariably needed in higher proportion than boron for improving growth and sap characteristics. Similar helpful effects were recorded by McMurtray[5] and Martin.[6] A detailed discussion of these results appears elsewhere.[2]

Plant Physiol. Lab., College of Agric., Banaras Hindu University, Banaras-5, *June* 6, 1955.

K. N. LAL.
J. N. TANDON.

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A TECHNIQUE OF WHOLE MOUNTS FOR THE STUDY OF FLORAL ANATOMY

THE present note describes an easy and quick method of whole mounts for the study of floral anatomy.

Young flowers, fixed in F.A.A., or in killing fluids containing chromic acid[2] for at least 24 hrs. and washed with water, are treated with 10% KOH sol. in distilled water for 12 to 24 hrs.; or, to hasten the process, they may be boiled for 5 minutes. The material, which becomes somewhat transparent after the treatment, should be selected. Old fixed materials and also those that contain abundance of tannin become black with this treatment. In such cases, fresh material should be taken and it should be treated to remove the tannin.[3] Small flowers are cleared in KOH before being stained and dissected under the binocular, but for bigger flowers, the floral parts are separated

before the treatment. The ovary of bigger flowers may be cut into two halves, if convenient. When the material becomes transparent to some extent, it is washed thoroughly with distilled water and stained with basic fuschin prepared after de Tomasi,[1] but no hydrolysis of the material with 1/N HCl is, however, needed. When the material takes a deep red stain (after nearly 1 to 2 hrs.), it is removed and washed thoroughly with tap-water. The stained material is then transferred to lactophenol for 2 to 4 hrs., which removes the excess of stain and also makes the material perfectly transparent. Only the lignified parts retain the stain while the whole material becomes destained and soft. Such stained materails, mounted on a slide in glycerine jelly, are studied directly under a microscope. Nevertheless, this technique may conveniently be applied for the study of thickenings of the xylem elements, the endothecium of anthers, and to some extent, the transmitting strand of the style, the calyx segments and the corolla parts. Figs. 1,

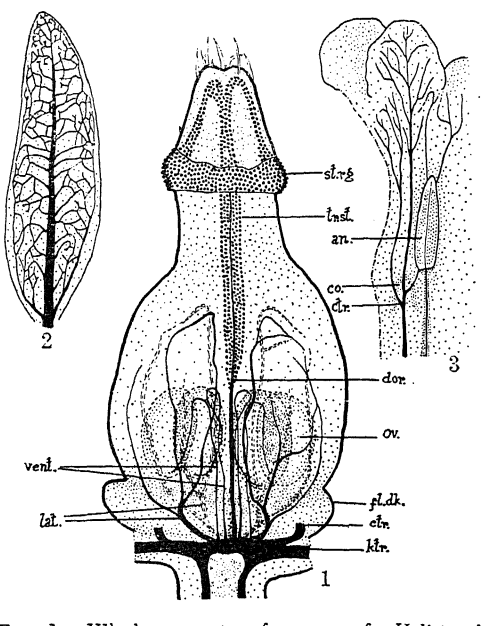


FIG. 1. Whole mount of ovary of *Heliotropium indicum L.*, *ctr.* = corolla trace; *dor.* = dorsal trace; *fl. dk.* = floral disc; *ktr.* = calyx trace; *lat.* = lateral trace; *ov.* = ovule; *st.rg.* = stigmatic ring. *tr. st.* = transmitting strand; *vent.* = ventral trace, × 15.

FIG. 2. Whole mount of calyx segment showing closed venation. *H. indicum* L., × 4.

FIG. 3. Whole mount of a portion of corolla; *an.* = anther, *co.* = corona, × 4.

2 and 3 have been drawn from the whole mounts of the flower of *Heliotropium indicum* L., a detailed account of the floral anatomy of which will be found elsewhere.[4]

The author is grateful to Dr. Bahadur Singh, Dr. R. K. Singh and Ch. Shiva Singh for guidance, facilities and encouragement.

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USE OF SYNTHETIC HORMONE TO STEP UP SUGAR IN CANE

FOLIAR spray of 2, 4-dichlorophenoxyacetic acid at very low concentrations was reported by Beauchamp[1-3] to increase sucrose content of cane. Subsequent workers, however, failed to get consistent statistically significant results.[4-7] As all the work referred to above consisted of laboratory juice analyses on representative cane samples drawn from small experimental plots (necessarily entailing a certain amount of sampling error) and did not take into consideration actually determined values of sugar in cane (which could be calculated only roughly from juice analysis results), it was considered necessary to carry out large-scale tests under actual manufacturing conditions to settle the issue conclusively. For this purpose, trials were arranged with three varieties of cane (each at a different place), the treatment involved being a spray of 2, 4-dichlorophenoxyacetic acid (sodium salt) at a concentration of 50 p.p.m. applied at 60 gallons per acre. Large blocks of 8-10 acres under the same variety were used in the experiments, alternate strips of about an acre in size (separated by 15′ buffers on either side) being used as treated and control plots. The entire crop in treated and control plots was harvested at the same time and subjected to mill tests at the factory.

It will be seen from Table I that the spray treatment brings about increases in sugar recovery varying between 0·33 and 0·80 unit in all the six tests carried out, the effect being noticeable as early as 2 days after spraying and remaining unimpaired after a lapse of 31 days. It is also noteworthy that the treatment proves effective even when applied at a stage not much earlier than the peak maturity phase, as evident from the high purity of mixed juice recorded in controls 2 days after the date of

TABLE I

Particulars	I Majhaulia (Nawtan Farm) Variety : B.O. 10 Spray : 28th January Harvest : 30th ,, (Interval : 2 days)		II Majhaulia (Nawtan Farm) Variety : B.O. 10 Spray : 30th January Harvest : 26th February (Interval : 27 days)		III Majhaulia (Dumri Farm) Variety : B.O. 17 Spray : 29th January Harvest : 31st January (Interval : 2 days)	
	Treated	Control	Treated	Control	Treated	Control
Sugar % cane ..	14·08	13·75	14·39	13·85	14·12	13·52
Fibre % cane ..	16·78	17·16	18·05	18·85	16·62	17·20
Mixed juice purity ..	89·54	88·64	88·81	87·22	85·79	84·25
Estimated recovery ..	11·88	11·55	12·15	11·55	11·80	11·25
Improvement in estimated recovery	0·33	..	0·60	..	0·55	..

Particulars	IV Majhaulia (Dumri Farm) Variety : B.O. 17 Spray : 31st January Harvest : 28th February (Interval : 28 days)		V Majhaulia (Dumri Farm) Variety : B.O. 17 Spray : 31st January Harvest : 3rd March (Interval : 31 days)		VI Hassanpur (Chakthat Farm) Variety : B.O. 11 Spray : 17th February Harvest : 19th February (Interval : 2 days)	
	Treated	Control	Treated	Control	Treated	Control
Sugar % cane ..	13·62	13·28	14·36	13·60	14·07	13·43
Fibre % cane ..	18·85	19·22	19·55	20·45	17·62	14·19
Mixed juice purity ..	83·26	82·52	84·46	83·74	87·48	85·07
Estimated recovery ..	11·40	11·03	12·00	11·20	11·74	11·10
Improvement in estimated recovery	0·37	..	0·80	..	0·64	..

spraying. Statistically, the improvement in sugar recovery is highly significant and the same holds good for sugar per cent. cane and purity of mixed juice. The method therefore holds out great promise for the sugar industry, particularly in view of the insignificant costs involved (6 annas per acre as the cost of hormone and wetting agent used). Arrangements are under way for aerial spraying of the entire reserved areas of all factories in the district of Champaran.

The authors are indebted to the Government of Bihar and the Indian Central Sugarcane Committee for financing the scheme of which the present work forms a part and to M/s. M. P. Sugar Mills, Majhaulia, and New India Sugar Mills, Hassanpur, for extending necessary facilities. The assistance rendered by Sri. R. D. Sahi, Analytical Assistant, during the course of these trials is also acknowledged.

Central Sugarcane Research Station, Pusa, Bihar, *June* 21, 1955.

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ABILITY OF THE WHITE-FLY TO CARRY MORE THAN ONE VIRUS SIMULTANEOUSLY

THE cotton white-fly (*Bemisia tabaci* Gennad) in India is phytophagus[5,9,10] and has been found to be the vector of a number of virus diseases affecting cultivated crops and weeds in India.[1-6] Experiments were conducted to study the transmission of viruses by white-fly which had acquired two viruses, *viz.*, the yellow vein-mosaic of *bhendi* (Fig. 1) and yellow vein-mosaic of pumpkin (Fig. 2).

The symptoms, host range and virus vector relationships of *bhendi* yellow vein-mosaic have already been published in detail.[7,8] The virus of yellow vein-mosaic of pumpkin is new; therefore, its symptoms, etc., are described here in brief. The virus is not sap transmitted but

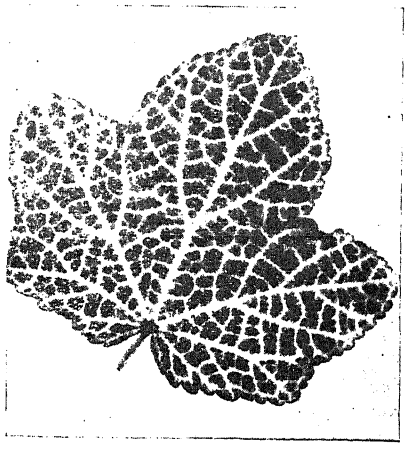


FIG. 1. A *bhendi* leaf showing yellow vein-mosaic.

can be readily transmitted by the white-fly. The disease causes pronounced vein clearing and irregular chlorotic patches on the lamina (Fig. 2). The internodes also become somewhat yellow and the fruits, which do not develop to normal size, have yellow patches on the outside. The yield goes down markedly. This

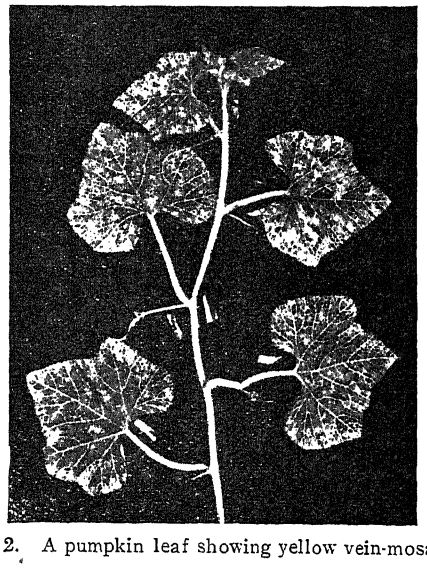


FIG. 2. A pumpkin leaf showing yellow vein-mosaic.

virus does not infect *bhendi* nor any other plant in Malvacæ. In addition to pumpkin the virus also infects *Cucurbita pepo* L., and *Cucumis sativus* L. Like the *bhendi* yellow vein-mosaic virus, it has a short incubation period in the white-fly and persists for life in the vector.

White-flies raised in insect-proof glasshouse on healthy cotton plants were first fed for 24 hours on diseased *bhendi,* and then during the next 24 hours on diseased pumpkin plants and *vice versa.* Samples of insects from the two lots were transferred to healthy *bhendi* and pumpkin plants in succession for 9 days allowing them to feed for 24 hours on each host.

Observations indicated that the respective viruses were transmitted to the hosts from which they were acquired by the vector. Similar results were obtained when the feeding period on healthy test plants was reduced to 12 hours.

The results reported here conclusively show that the cotton white-fly is capable of harbouring two different viruses simultaneously and can readily cause infection in healthy host plants susceptible to the respective virus on the same day and can continue to do so for several days without having recourse to the source of infection. Further work with more than two viruses is in progress.

Most of the data recorded so far on the ability of an insect vector to carry more than one persistent virus relates to leaf hoppers.[11-15] The results reported in this paper are the first record of this nature for white-flies.

Grateful thanks are due to Dr. R. S. Vasudeva for guiding the investigation. Thanks are also due to the Indian Council of Agricultural Research for financing the scheme under which the present investigation was carried out.

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REVIEWS

Squaring the Circle and Other Monographs. By E. W. Hobson and others, Chelsea Publishing. Co., 1953. Pp. 361. Price not given.

This is not one book, but four different booklets reprinted between the same two covers.

The first of them, "Squaring the Circle" by E. W. Hobson published in 1913, covers the first 57 pages and describes the three stages of the history of this famous problem. The first or geometrical period extends from the earliest times to the invention of the calculus in which the approximate determination of π was based on the calculation of the sides or areas of regular in- or circumscribed polygons, while in the next stage covering about a century, convergent series, products and continued fractions were called into service. During the last stage which extended up to the late 19th century, attention was centred on the nature of π and of e, their irrationality, transcendence (non-algebraic character), etc.

The second book, "Ruler and Compasses" by Hilda P. Hudson, Longmans, Green & Co., discusses in its 131 pages the kind of algebraic equations which correspond to geometrical constructions involving the ruler, or compasses or both. There is also a discussion of how to get over the limitations of a small sheet of paper and that of a blunt pencil. It is also shown that any Euclidean construction can be carried out with the use of one circle and the requisite number of straight lines or else the required number of circles and no straight lines at all.

The third book is by Dr. A. N. Singh and was originally published by the Lucknow University Press. In its 110 pages, there is a systematic account of the Theory and Construction of Non-differentiable Functions in four lectures. In the first the author proves the non-existence of the derivative of Weirstrass's function, explains Dini's method of constructing non-differentiable functions, and also considers other functions such as Riemann's, Bolzano's, etc. Geometrical methods of getting curves without tangents and of space-filling curves are then explained, while the last two lectures deal with functions defined arithmetically and with the properties of non-differentiable functions.

The last booklet of 51 pages entitled "How to Draw a Straight Line" is by A. B. Kempe and was originally published by Macmillan & Co., in 1877. It deals with various plane linkages to obtain approximate and exact straight line motion. All the booklets deal with problems of absorbing interest whose appeal does not diminish with the lapse of years.

A. NARASINGA RAO.

Handbook of Ostracod Taxonomy. By Henry V. Howe. Physical Science Series No. 1. Louisiana State University Press, Baton Rouge, La., U.S.A., 1955. Price $ 5.00.

During the past couple of decades considerable advances have been made in the study of ostracoda as a result of the interest taken by palæontologists engaged in the petroleum industry. Collection of taxonomic information from the resulting large number of publications is no mean task and the debt students of ostracoda owe Dr. Howe for providing this information in a convenient *Handbook* is indeed very great. Compiled by an author who has had the benefit of over 25 years' experience the *Handbook* —the first of its kind on Ostracoda—fulfils a long-felt need.

In the introduction the author indicates the general layout of the *Handbook*. The first part consists of taxonomic terms arranged alphabetically and runs through 197 pages containing nearly 1,200 entries. The second part gives the bibliography (182 pages) and contain references of almost all available ostracod literature published up to the end of 1952. A supplement at the end contains some important additional references published since 1952. The author feels certain that there exists much published literature in the U.S.S.R. and allied countries of which he has no information.

A minor omission in the bibliography is a reference to a paper by Mary H. Latham published in 1938 in the *Proceedings of the Royal Society of Edinburgh*, Vol. 59 (*i*), No. 4, entitled "Some Eocene Ostracoda from North-West India". As the author has himself indicated, such minor omissions are bound to be present in a work of this kind, but these should in no way minimise the usefulness of the *Handbook*.

The author has shown that many recently published generic names are homonyms or

synonyms and the present work should help in considerably reducing the publication of invalid names in future. Ostracod workers all over the world will find the *Handbook* a most useful reference book, and in India where a serious study of fossil ostracoda is yet to be started, this *Handbook* will be found invaluable.

Y. NAGAPPA.

Mathematics for Engineers. Part I. By W. N. Rose. Ninth Edition. Revised. (Chapman & Hall.) Pp. 528. Price 21 *sh.* net.

The Directly Useful Technical Series attempts to occupy a midway position between technical books which are theoretical and those which are practical. The problems are of a directly useful type and at the same time contain the proper amount of scientific explanation so as to satisfy the enquiring mind. The book, which is one of the above series, was first published in 1918 and has now run into the ninth edition.

Part I treats of the fundamental processes of Algebra, Plane Trigonometry, Mensuration and Graphs in a graded manner. Particular mention must be made of Chapter X, headed 'The Determination of Laws' in which examples from different branches of engineering are taken to explain the method of determining the laws to suit different types of data. The next chapter on the construction of Practical Charts deals with logarithmic plotting and alignment charts and should prove to be of much practical interest.

The treatment of the various topics is lucid and leaves nothing to be desired, and the get-up is good.

K. RAMANUJACHARYA.

(*i*) **Electrical Characteristics of Overhead Lines.** By S. Butterworth. (Technical Report Ref. O/T4A.) (Electrical Research Association, England), 1954. Pp. 238.

(*ii*) **Handbook on Electrical Characteristics of Overhead Lines.** (Technical Report O/T4A.) (Electrical Research Association, England), 1953. Pp. 20. Charts 14. Price 15 *sh.*

(*i*) The volume under review presents in convenient form, the theoretical considerations which decide the electrical characteristics of overhead power lines, and the practical estimation and application of these characteristics.

There are several text-books on overhead line practice to meet the needs of the students. There are also handbooks which cover, besides overhead line data, a wide range of subjects. Further, the tabulations in most of the handbooks do not relate to the British practice. But the book under review contains formulæ relating to the behaviour of the line in very great detail, with the theoretical derivation of all formulæ used, and with sufficient discussion of some refinements. These refinements, though rarely entering the field of practical applications, may have to be studied in any academic or other detailed investigation.

To obtain rapidly and with moderate accuracy those values which frequently occur in British practice, the book presents aids to calculation in the form of alignmest charts by means of which any particular characteristic of a line of given construction can be calculated using only a slide rule.

The book comprises nine chapters. A chapter each is devoted to resistance of transmission lines, inductance, capacitance and susceptance of single phase transmission lines for both stranded and hollow conductors. The fourth chapter deals with the characteristics of three-phase transmission lines with balanced currents and voltages with and without transposition for single circuit lines. Characteristics of double-circuit three-phase untransposed lines are also given in terms of distance between phases so that they may be applied to any arrangement of current in the six conductors. The next chapter deals with the current ratings of overhead lines and gives the current rating formulæ taking into consideration the different factors influencing the rise in temperature of the conductors.

Chapter VI deals with transmission line characteristics under unbalanced conditions. A general theory of unsymmetrical transmission is developed by the method of symmetrical components. Formulæ for impedances are developed for single circuit and double circuit lines with or without earth wires. Conditions obtaining in double circuit system with one circuit earthed are discussed. Effect of multiple earths on sequence impedances and on the magnitude and distribution of earth fault currents are dealt with. Sequence capacitive impedance and surge impedance are discussed, and the scheme of calculation for sequence impedances normally required for single circuit and double circuit systems with or without earth wires is described in detail. The other chapters deal with corona and corona losses, multiple conductor systems, and voltage regulation for short and long lines.

(*ii*) The *Handbook* summarizes for easy reference those sections of the book by S. Butter-

worth which are most frequently required to aid calculation.

Tables and alignment charts, by means of which the basic electrical constants, current ratings, corona losses and power transmission of overhead lines may be obtained with a minimum of calculation are included. The alignment charts are in a format intended to facilitate their use in the field. Practical examples of calculation for the single-circuit and double-circuit 132 KV lines are given. An illustrative example of calculations for a circuit with multiple conductors is also included.

While both the books are very useful in transmission line engineering, the former will especially be useful to students, teachers and advanced workers in academic work and other investigations.

C. S. GHOSH.

Emulsion Polymerization. By **Frank A.** Bovery, I. M. Kolthoff, Avrom I. Medalia, Edward J. Meehan. (High Polymers, Vol. IX); (Interscience Publishers, Inc.), 1955. Pp. xii + 445. Price $ 12.5.

The book is the first of its kind on emulsion polymerization which finds very extensive practical applications such as the production of synthetic rubber in recent times. In this monograph are presented in a very brief and systematic way the interpretation of various aspects with special emphasis on kinetics of emulsion polymerization.

Chapters II and III deal with the various types of free radical initiators in general and especially in emulsion polymerization. Use of modifiers in the production of synthetic rubber is of great importance. Action of chain transfer, reagents, modifiers as they are called, their general kinetic aspects in emulsion polymerization and a lucid account of molecular weight distributions are given. The importance of detergents has been discussed. A complete account of the kinetics of emulsion polymerization as well as inhibition and retardation presented in Chapters VI and VII will prove highly useful for researchers engaged in investigation of high polymers. Copolymerization in emulsion polymerization of a few systems like styrene and acrylonitrile, styrene and methylmethacrylate, styrene and butadiene have been discussed. The chapter on experimental methods in emulsion polymerization in the research laboratory as well in industry will prove very useful for a research chemist in high polymers. A standard G.R.S. recipe discussed in all its aspects gives an overall picture of the nature of emulsion polymerization in industry.

Work on emulsion polymerization especially from the fundamental point of view started just over a decade ago and yet the number of publications on this aspect of high polymers alone are so varied and numerous that it is hardly possible for researchers to follow and to have a unified picture. The monograph under review very ably serves this urgently felt need.

M. SANTHAPPA.

A Symposium on Amino Acid Metabolism. Edited by W. D. McElroy and H. Bentley Glass. (The Johns Hopkins Press, Baltimore), 1955. Pp. xvi + 1048. Price $ 12.50.

The McCollum-Pratt Institute of Johns Hopkins University has been holding several symposia during the last few years on subjects of major biochemical importance. In one such symposium organised in June 1954, the latest developments in our concepts of metabolism of amino acids, both essential and non-essential were reviewed and discussed by a large number of distinguished scientists all of whom had extensively carried out investigations on different aspects of this subject. The volume under review gives an account of this symposium, of the papers read, and of the discussions which took place after the presentation of the papers together with a lucid summary in the end written by Dr. Bentley Glass.

The amino acids have been arbitrarily divided, for convenience, into several groups and the metabolism of each group presented and discussed by one or more research workers. Thus, after a general consideration of amino acid metabolism by A. Meister, C. B. Thorne, W. W. Umbreit, E. F. Gale and others, the following groups of amino acids have been specially dealt with: (*i*) metabolism of glutamic acid, proline, ornithine, citrulline and arginine, by S. Ratner, M. Stetten and E. L. Oginsky, (*ii*) metabolism of histidine, leucine, isoleucine, valine and lysine, by B. N. Ames, H. Tabor and O. Hayaishi, (*iii*) metabolism of methionine, cysteine and threonine, by J. A. Stekol, T. P. Singer and G. L. Cantoni, (*iv*) metabolism of glycine and serine by S. Weinhouse, W. Sakami and D. Shemin, (*v*) metabolism of aromatic amino acids, by B. D. Davis, D. B. Sprinson, W. E. Knox and C. Yanofsky. In all the papers, exhaustive details of experiments carried out have been given and the conclusions reached by the authors have been critically examined by the

various participants in the course of the discussion. Isotope labelled amino acids and their intermediates have been extensively used in several investigations, and the isolation and study of various enzyme systems involved in amino acid metabolism have geen presented in great detail. The interrelationship of methionine, citrulline and other amino acids, and the relation between tryptophane and niacin synthesis in various organisms have been reported in this volume in a comprehensive manner and future developments in these fields have also been indicated. The summary at the end is extremely useful in that it gives a clear and cogent picture of the whole symposium in a nutshell.

The get-up of the book is excellent, and the volume should prove extremely valuable to all biochemists as well as physiologists who wish to keep themselves posted with the latest developments in this fascinating field of amino acid metabolism.

P. S. SARMA.

The Book of Indian Birds. Fifth Edition. By Salim Ali. (The Bombay Natural History Society, Bombay), 1955. Pp. vi + 142. Price Rs. 20.

As one who has followed the progress of 'The Book of Indian Birds' from its first publication in 1941, I have no hesitation in acclaiming the latest edition. Mr. Salim Ali has indeed succeeded in producing a book that will stimulate popular interest in our bird life and expertly assist the man-in-the-street in identifying the bird in the bush with certainty, ease and pleasure. The book is slimmer than its predecessors and more 'pocketable'; the old illustrations, which were rather poor, have been replaced completely with new coloured plates, showing four species to the plate; and one notes with pleasure that the original, comprehensive and vivid text has been retained, though slightly abridged.

Much of the credit for transforming what was an useful book into a very attractive and authoritative field-guide should go to the artist, D. V. Cowen. One feels that the reproduction of the plates has not done justice to her work—the yellows in the depictions of the iora and the orioles on Plates 4 and 14, for instance, are muddy, and, in certain plates, the colour lacks colour. I do not think that authentic æsthetic originality can be claimed for all the artist's bird studies; for example, her moorhen at Plate 42 is reminiscent of Roger Tory Peterson, and some of the depictions of common birds, such as the roller on Plate 27 and the hen kœel and Brahminy Kite on Plates 26 and 36, can certainly be improved. But admittedly this is petty criticism of work that is valuable. On Plate 6 the numbers of the Collared Bushchat and Redstart should be interchanged.

A suggestion for the next edition: the common English names of certain Indian birds which had currency till recently, have been wholly left out. Thus, we find *Eremopterix grisea*, so long known by the name 'Ashy-crowned Finch-Lark', now listed only by the new name, the black-bellied Finch-Lark. The former name was unquestionably a poor one and the current one is more descriptive, but for the sake of readers who knew such birds by their now-obsolete names, those names may be listed in an aside without adding to the bulk of the book.

M. KRISHNAN.

Books Received

The Physiology of Diapause in Arthropods. By A. D. Lees. (Cambridge University Press), 1955. Pp. x + 150. Price 12 *sh.* 6 *d.*

Annals of Applied Biology—Proceedings of the Jubilee Meeting Held in London, 13-17 Sept. 1954. (Cambridge University Press), 1955. Vol. 42. Pp. ix + 414. Price 25 *sh.*

Centrifugal and Other Rotodynamic Pumps. Second Edition. By Herbert Addison. (Chapman & Hall), 1955. Pp. x + 530. Price 50 *sh.*

High Energy Nuclear Physics (Proceedings of the Fifth Annual Rochester Conference, Jan. 3-Feb. 2, 1955.) Compiled and Edited by H. P. Noyes, E. M. Hafner, G. Yekutieli and B. J. Raz. (Interscience Publishers, Inc.), 1955. Pp. 197. Price $ 2.50.

Light Calculations and Measurements—An Introduction to the System of Quantities and Units in Light Technology and to Photometry. By H. A. E. Keitz. (Philips Technical Library.) (M/s. Philips Electrical Co., India, Ltd., 7, Justice Chandra Mahtab Road, Calcutta-20), 1955. Pp. xvi + 413. Price Rs. 25.

Cumacea of the Benguela Current. By N. S. Jones. (*Discovery Reports,* Vol. XXVII, pp. 279-92.) (Cambridge University Press), 1955. Price 6 *sh.* 6 *d.*; *The Wax Plug in the External Auditory Meatus of the Mysticeti.* By P. E. Purves. (*Discovery Reports,* Vol. XXVII, pp. 293-302.) (Cambridge University Press), 1955. Price 10 *sh.* 6 *d.*

Andhra University Memoirs in Oceanography, Vol. I. (Andhra University, Waltair), 1954. Pp. iv + 162. Price Rs. 15.

SCIENCE NOTES AND NEWS

Ford Prize for Peaceful Uses of Atomic Energy

The establishment by Mr. Henry Ford of a million dollar fund to provide "atoms for peace" awards on a worldwide basis was announced recently. These will be on a worldwide basis, and will be made by an international jury which will each year select an individual or group of individuals to receive a $ 75,000 award. The award will be made without regard for nationality or political belief, and will constitute a memorial by Mr. Ford and his brothers to their father. If no award was made, the money would be used for scholarships and fellowships to scientists most likely to contribute to the advancement of the new science of the peaceful application of atomic energy.

Rauwolfias for Research

M/s. Rajaranga & Company, Ltd., 5, Thambu Chetty Street, Madras-1, write that they have about 1,000 lb. of *R. beddomei* and 200 lb. of *R. micrantha* for gratuitous distribution to research organizations for investigational purposes, and will be glad to forward samples, on request, on F.O.R. Madras basis.

International Conference on Nuclear Reactions

An International Conference on Nuclear Reactions is being organised by the "Nederlandse Natuurkun-dige Vereniging" to be held in Amsterdam during July 1-7, 1956.

Among the topics discussed will be: Elastic and inelastic scattering, capture- and photo-reactions, stripping- and pick-up reactions, fission. Further particulars can be obtained from the Conference Committee's Secretary, Dr. S. A. Wouthuysen, Zeeman Laboratorium, Mindergracht 4, Amsterdam (c), Netherlands.

Gabriella Zuccari Scholarship for Zoological Research

The University Padua is offering a Gabriella Zuccari scholarship of 300,000 lire for research of at least six months duration at the Zoological Station, Naples, during the academic year 1955-56. The scholarship is open to any person who wishes to undertake research in zoology, comparative anatomy, physiology or embryology and it may be renewed up to a maximum of three years. Application forms, to be returned by October 31, and further information can be obtained from the Secretariat of the University of Padua.

Centenary of Aluminium

The Electrochemical Society, India Section, is planning to celebrate the Centenary of Aluminium during mid-September 1955 in conjunction with other scientific societies in Bangalore. The technical meetings will deal with the present status and the projected future of aluminium industry in India, its use in aircraft, rail and automobile industries, and its role in consumer industries such as cables and conductors, utensils, paints, foils, chemicals and others. The *Bulletin of the Electrochemical Society* intends to bring out a special issue in October wholly devoted to aluminium.

Award of Research Degree

The Andhra University has awarded the D.Sc. Degree in Physics to Shri D. Premaswarup for his thesis entitled, "Some Intensity and Perturbation Calculations in Complex Molecular Spectra and the Structure of the Band Spectrum of Tantalum Oxide", and the D.Sc. Degree in Technology to Shri M. V. Raghavacharya for his thesis entitled, "Vapour Liquid Equilibria of Non-Ideal Solutions".

A New Type of Plant Growth-Regulating Substances

Van der Kerk and others of the Institute for Organic Chemistry T.N.O. Utrecht, report the plant growth-regulating properties of S-(carboxymethyl)-dimethyl dithiocarbonate, obtained by the reaction of sodium dimethyldithiocarbamate with monochloroacetic acid. They suggest that such an activity in this series of compounds is connected with the possibility of N-C bond acquiring a double bond character as a consequence of similar interval electron shifts. This activity is maintained if one of the hydrogen atoms in the CH_2 group is replaced by alkyl group but not when both are replaced. The interesting new feature observed with these compounds seems to be that the electron shifts caused by simple substitutions in the remaining part of the molecule may, or may not, lead to the specific spatial arrangements required for the growth-promoting activity. (*Nature*, 1955, 176, 308.)

First Congress on Theoretical and Applied Mechanics

The dates for holding the First Congress on Theoretical and Applied Mechanics have now been fixed as November 1 and 2 (see earlier notice in *Curr. Sci.*, 1955, **24**, 138). Detailed programme along with a printed copy of the abstracts of the papers to be presented before the Congress will be sent to those who register. There will be a few half-hour invited addresses on selected topics. Those who wish to contribute papers are requested to send the abstracts, the registration form and the fee of Rs. 6 before September 30, 1955, to the Organizing Secretary.

It is also proposed to form a National Society for Theoretical and Applied Mechanics, and suggestions regarding its scope and constitution are welcome.

Fission Physics and Nuclear Theory

The latest discovered element, mendelevium, has an atomic number of 101. How many more elements will it be possible to discover? According to a prediction by Dr. John A. Wheeler, of Princeton University, Princeton, New Jersey, U.S.A., made in his paper prepared for the United Nations Conference on Peaceful Uses of Atomic Energy, it may be possible to isolate long enough for experimental observation nuclei with a charge of up to 170, compared to uranium's 92 and a mass of 650 (compared to 255 for the latest discovered nucleus).

Such a nucleus would be over twice as heavy as any known nucleus. It would exist perhaps only one ten-thousandth of a second before splitting. Its interest would presumably be purely scientific, not technical. It might be made by very intense and sudden neutron irradiation of uranium.

Radiosonde on Board Ship

The possibility of making radiosonde observations on board merchant ships has frequently been discussed and the Commission for Maritime Meteorology has recommended that investigations of the problems involved should be undertaken. Information has been received of a programme being carried out in co-operation between the U.S. Weather Bureau and the Department of the Navy which should provide useful information on this subject. A transport vessel, *General Gaffey*, has been equipped with apparatus for making upper air soundings, and is making observations, for an experimental period of a year, on voyages between San Francisco and Yokosuka, Japan. Finnish radiosondes have been selected for this purpose in view of their light weight and consequent economy in balloons and helium. It is hoped to achieve regularly a ceiling of 300 mb. with 100 g. balloons.

International Co-operation on Purification of Brackish Water

In many countries, difficulty is being found in providing the increasing quantities of fresh-water required for domestic and industrial use. For example, sea-water is infiltrating into fresh-water wells in the Thames estuary and it is becoming more and more difficult to suggest other sources that do not involve expensive, long-distance pumping. Talks on the possibilities of various methods of desalting water have been going on for some time under the auspices of O.E.E.C. One promising process is electrodialysis—the removal of salts from a liquid flowing between pairs of ion-selective membranes, by means of an electric field. Research on this method is already well-advanced in the Netherlands. The Dutch recently offered to carry out development work in co-operation with other countries showing an interest. Great Britain has joined the Netherlands, South Africa, Australia and Algeria (representing France) in paying for this work; the problems to be solved are mainly those of bringing up the process from small to large pilot-plant scale.

Paper from Banana Stems

The manufacture of paper from abaca (*Musa toztillos*) suggests the possibility of using *Musa sapientum* stem and stems of other varieties of banana for paper manufacture. Like the process evolved for abaca, the banana stem is divided into strips and allowed to dry, in shade, till the moisture content is reduced to 30%. Those are then crushed, extracted and bleached using first a 5% sodium carbonate solution (which can be used 3 or more times) followed with a bleaching powder solution of about 5%. The low yield of the fibre is compensated by the cheapness of the process, the low cost of investment and chemicals, the possibility of pulping the fibres in beaters and the profit from the fruits. Further advantage could be gained by locating the mill in banana plantations.

—*Chemical Age.*

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THE ELASTICITY OF CRYSTALS*

THE materials used in engineering construction are mostly polycrystalline solids and their elastic behaviour is of the utmost practical importance. It follows that the subject of the elasticity of crystals is of more than merely academic interest. Of recent years the importance of its study has greatly been enhanced by several circumstances. The experimenter today can in many cases work with synthetically prepared crystals of large size and good quality. He has at his disposal several new techniques enabling him to determine their elastic behaviour and obtain precise results. These techniques are mostly based upon the production of waves or standing oscillations in the crystal with the aid of piezoelectric oscillators. These latter oscillators are themselves of importance in technical acoustics and communication engineering. The subject also stands in the closest relation to the structure of crystals as revealed by X-ray diffraction and spectroscopic studies. It is thus an integral part of the rapidly developing physics of the solid state.

2. The Notions of Stress and Strain

The science of elasticity is based on the fundamental notions of stress and strain and —subject to a restriction on their magnitude— on the proportionality between them known as Hooke's law. The precise definition of stress and strain is thus a matter of fundamental importance. Such definitions have necessarily to be comprehensive. They have to cover cases where their magnitudes vary from point to point within the crystal and also cases in which the stresses and strains vary with time as in the theory of wave-propagation. It is essential, further, that they take account of the elastic anisotropy which all crystals exhibit, in other words, the fact that the effect of an impressed

*1. "On the Theory of the Elasticity of Crystals," by Sir C. V. Raman and Dr. K. S. Viswanathan; 2. "Evaluation of the Four Elastic Constants of Some Cubic Crystals," by Sir C. V. Raman and D. Krishnamurti. Memoirs Nos. 73 and 76 of the Raman Research Institute, Bangalore, *Proc. Ind. Acad. Sci.*, 1955, **42**, 51 and 111.

force depends on the direction in which it is applied.

An important remark which should be made here is that it is unnecessary to introduce atomistic considerations in defining stress or strain. This is obvious since the phenomena with which we are concerned are open to macroscopic observation. To take account of the variability of stress and strain with the location we define these quantities in relation to a particular point within the solid. The legitimacy of this procedure rests upon the fact that it is possible to imagine the volume of the substance to be divided into elements of such small dimensions that each element can be regarded as a mass particle and yet is large enough to justify its physical properties being assumed to be the same as those of the material in bulk. We are thereby enabled to specify the position of any volume element by its three co-ordinates in space and its state of equilibrium or of motion in terms of simple forces or tractions acting on the volume element.

3. The Elastic Constants

The foregoing remarks are preliminary to a specification of stress and strain which is logically consistent with the approach made to the subject. We define stress in terms of the tractive force assumed to act on an infinitesimal area drawn through a given point within the solid. Since this area can be set normal to each of the three co-ordinate axes in turn and for each such setting the acting force can be resolved into three components parallel to these axes respectively, we have nine components of stress. Likewise, strain is expressed in terms of the difference in displacements of two neighbouring points within the solid. Since the line joining these two points can be set parallel to each of the three co-ordinate axes in turn and the difference of their displacements in each case can itself be resolved along each of these axes in turn, we have nine components to deal with. The stress-strain relationships of proportionality would in the general case thus involve 9×9 or 81 elastic constants. The well-known law of reciprocity which enables us to interchange the directions of force and displacement without change in the constant of proportionality between them results in the number 81 being reduced to $(9 + 36) = 45$ constants in all. Thus, it requires 45 elastic constants to describe the elastic behaviour of a triclinic crystal. For crystals of other classes, the number of independent constants is diminished by reason of their symmetry properties, the more so the higher the symmetry of the crystal. The number of independent elastic constants in each case can be readily worked out using the formulæ based on group theory given by Bhagavantam. Table I exhibits the situation thus disclosed. The first column shows the symmetry class in the usual language of crystallography, while column II shows the subdivisions of those classes grouped together according to their elastic behaviour. The third column shows the number of independent elastic constants for these sub-classes.

Table I

Crystal system	Point Group (Schoenflies notation)	No. of Elastic Constants		
		General	Dynamic	Classical
Triclinic ..	All	45	36	21
Monoclinic ..	All	25	20	13
Orthorhombic	All	15	12	9
Tetragonal	C_4, S_4, C_{4h}	13	10	7
	D_4, C_{4v}, D_{2d}, D_{4h}	9	7	6
Trigonal	C_3, S_6	15	12	7
	D_3, C_{3v}, D_{3d}	10	8	6
Hexagonal	C_6, C_{3h}, C_{6h}	11	8	5
	D_6, C_{6v}, D_{3h}, D_{6h}	8	6	5
Cubic	T, T_h	5	4	3
	O, T_d, O_h	4	3	3

4. Wave-Propagation in Crystals

Writing down the equations of motion of the volume of elements of the medium in terms of the space variations of the stress components acting upon them, one can investigate the propagation of waves through the material. It emerges that in any given direction within the solid, three types of waves can be propagated, their velocities being different in each case and also varying with the direction. The wave velocity for each of the three types and for any particular direction of propagation is expressible as a function of the direction and of certain linear combinations of the elastic constants. The number of these combinations is less than the number of general elastic constants in each case. The number can be calculated from formulæ based on group theory and is shown in the fourth column of Table I.

5. Remarks on the Classical Theories

Cauchy, the celebrated French mathematician of the 19th century, in his memoir prese

to the Academy of Sciences at Paris in the year 1822 proposed a reduction of the number of components of stress and strain from 9 to 6 in each case. His arguments will be found reproduced in numerous text-books and indeed they form the basis of the mathematical theory of elasticity as hitherto developed. A critical examination shows however that those arguments are not sustainable. In the case of the strain components, the reduction was sought to be justified by eliminating movements which were thought to be rigid body rotations. Actually the quantities eliminated are differential rotations of the same nature as those which appear in the deformation of solids by torsion or flexure and which are quite as much a part of the elastic deformations as extensions and contractions. Hence their elimination is not justified. The argument on which the reduction of the number of stress components from 9 to 6 was based was that the angular momenta of the tractions acting on a volume element taken about each of the co-ordinate axes in turn and summed up should vanish. But since by definition the stresses are assumed to be in the nature of tractive forces acting on volume elements small enough to be regarded as single mass particles, no consideration of angular momenta is called for. Indeed, once we accept the definitions of stress and strain, it becomes logically imperative to take account of all the nine components of each.

On the basis of Cauchy's assumptions the stress-strain relations of proportionality are $6 \times 6 = 36$ in number and these by application of the reciprocity relationship reduce to $(6 + 15) = 21$ in all for a triclinic crystal. Their number is smaller for the crystals of higher symmetry classes and is shown in column 5 of Table I against each of them. The reduction in number of the stress and strain components from 9 to 6 is in effect equivalent to assuming that differential rotations within the solid play no part in the theory of elasticity and to imposing a corresponding restriction on the nature of the acting stresses. As already remarked, differential rotations play a fundamental role both in static deformations, especially in torsion, as also generally in wave propagation. In other words, the classical theory is of restricted validity confined to certain types of static deformation and to particular cases of wave propagation. Since however it has been employed to interpret experimental data in other cases as well, it is useful to express the 21 constants in terms of the more general 45 constants, thereby enabling the latter to be evaluated from the existing data of experiment.

6. The Data of Experiment

As will be seen from Table I the simplest cases of all are crystals belonging to the T*d* and the O*h* classes of the cubic system. The general theory gives four elastic constants which may be designated as respectively d_{11}, d_{12}, d_{44} and d_{45} while in the classical theory we have only three constants which have been designated as C_{11}, C_{12} and C_{44}. The linear combinations of the elastic constants which determine the velocities of wave propagation are in the former theory d_{11}, d_{44} and $(d_{12} + d_{45})$ while in the classical theory they are C_{11}, C_{44} and $(C_{12} + C_{44})$. Likewise, the expressions for the bulk modulus in the new and the old theory are respectively $(d_{11} + 2\,d_{12})/3$ and $(C_{11} + 2\,C_{12})/3$. Since the number of elastic constants of these classes is four, while the number of linear combinations that can be determined by dynamic measurements is three, it follows that at least one additional determination by static methods is necessary to enable all the four constants to be evaluated. The most appropriate of such determinations appears to be the bulk-modulus of which very precise measurements have been made by Bridgman and his collaborators at Harvard. It is necessary of course to correct the isothermal static value of the constant to obtain the adiabatic bulk modulus. Many other points have to be borne in mind: the bulk modulus reduced to zero pressures should be used; both the static and dynamic determinations have to be reduced to the same temperature of observation and finally the nature of the material used in the two cases has to be comparable.

In Table II are shown for 16 different crystals of the T*d* and O*h* classes, the values of the four elastic constants calculated in the manner explained. The three constants of the older theory are also shown in the table. The latter are those which appeared to be the most reliable values obtained by ultrasonic techniques, while the former were obtained by combining them with the value for the adiabatic bulk-modulus. The values of C_{11} and d_{11} are in each case identical; likewise those of C_{44} and d_{44}. But C_{12} and d_{12} are different and such difference is a measure of the failure of the three-constant theory to represent the actual elastic behaviour of the crystal. The difference between d_{44} and d_{45} also expresses the same situation in another way.

Certain general features emerge from the Table. For all the four alkali halides which are

TABLE II

Elastic constants in 10^{11} *dynes/cm.*^{2}

Substance	C_{11}	C_{12}	C_{44}	d_{11}	d_{12}	d_{44}	d_{45}
NaCl ..	4·877	1·232	1·269	4·877	1·34	1·269	1·16
KCl ..	4·038	0·663	0·628	4·038	0·779	0·628	0·512
KBr ..	3·455	0·56	0·507	3·455	0·655	0·507	0·412
NaBr ..	3·87	0·97	0·97	3·87	1·22	0·97	0·72
LiF ..	11·9	5·38	5·34	11·9	4·5	5·34	6·22
MgO ..	28·76	8·74	15·14	28·76	11·27	15·14	12·61
AgCl ..	6·05	3·64	0·624	6·05	3·482	0·624	0·782
Diamond ..	95	39	43	95	35·9	43	46·1
Ge ..	12·88	4·825	6·705	12·88	4·04	6·705	7·49
Si ..	16·56	6·386	7·953	16·56	6·56	7·953	7·78
ZnS ..	10·79	7·22	4·12	10·79	6·17	4·12	5·17
CaF_2 ..	16·6	4·87	3·58	16·6	4·29	3·58	4·16
Al ..	10·56	6·39	2·853	10·56	6·29	2·853	2·953
Cu ..	16·92	12·25	7·55	16·92	12·81	7·55	6·99
Ni ..	25·26	15·51	12·3	25·26	16·01	12·3	11·8
Ag ..	12·4	9·34	4·61	12·4	8·89	4·61	5·06

soluble in water, C_{12} is less than d_{12} and likewise d_{45} is less than d_{44}. This regularity of behaviour taken in conjunction with the reliability of the data in these cases makes it clear that these differences are real and justify us in concluding that the elastic behaviour of cubic crystals cannot be expressed in terms of three constants, but needs four. Diamond, germanium, zinc blende and fluorspar also exhibit a parallel behaviour which is the reverse of that shown by the four water-soluble alkali-halides. In their cases, C_{12} is decidedly greater than d_{12}, while *per contra* d_{44} is less than d_{45} and these differences are numerically more striking than in the case of the alkali-halides. Magnesium oxide for which the data are reliable exhibits a noteworthy behaviour; the differences between C_{12} and d_{12} and likewise between d_{44} and d_{45} are in the same sense as in the alkali halides but proportionately much larger. Differences of the same order of magnitude but in the opposite sense is shown by lithium fluoride. In the case of the metals crystallizing in the face-centred cubic system, we also find differences between C_{12} and d_{12} and between d_{44} and d_{45}, but they are not always in the same sense. This is a feature which need not surprise us in view of the very great differences exhibited by these metals in other respects.

C. V. RAMAN.

RADIATION EFFECTS IN COVALENT AND IONIC CRYSTALS

IN a paper presented at the Geneva Conference on the Peaceful Uses of Atomic Energy, J. H. Crawford, Jr., of the Oak Ridge National Laboratory, U.S.A., reports that the physical properties of many non-metallic solids, such as diamond, quartz and various crystalline salts undergo extensive changes when these materials are exposed to the high energy radiations emanating from nuclear reactors. Changes in colour, magnetic behaviour, density and crystal structure as indicated by X-ray studies have been observed.

For example, diamond specimens take on a dark, opaque appearance and their density decreases by 4% after extended bombardment with high energy neutrons which result from the fission of U 235 atoms. Once damaged to such an extent, annealing at high temperatures (which usually restores material to its initial conditions) can no longer produce a colourless crystal. Exposure of natural crystalline quartz to reactor radiations produces, relatively speaking, an enormous expansion of the crystals. As much as a 14% decrease in density has been observed. After exposure, X-ray studies indicate that the normal, ordered array of atoms which make up the quartz structure has been completely destroyed and the material is essentially structureless like a glass.

DOSAGES FROM NATURAL RADIOACTIVITY AND COSMIC RAYS

THE radiation dosages that people receive from the natural radioactivities and cosmic rays have been calculated and listed by W. F. Libby in an article reported in *Science* (1955, **122**, 57).

The dosages in milliroentgens per year for exposures directly over ordinary granite, typical sedimentary rock, and open oceans vary from 50 to 150. For comparison purposes, it is interesting to note that in the United States, the average exposure rate from total fallout from atomic tests on 1 Jan. 1955 was about 1 mr./yr. The total dose during 1954 probably averaged about 15 mr, principally because of the Pacific tests in the spring.

The dosage resulting from cosmic radiation was calculated from ionization chamber data, and from these the dosages were calculated at altitudes up to 20,000′ and at the latitude of 55° N. (geomagnetic) as well as at the geomagnetic equator. The cosmic ray dosage at sea-level varies from 33 to 37 mr./yr. It should be mentioned that the biological effects per unit energy may be larger for cosmic radiation, because it consists of high-energy particles rather than gamma radiation.

The natural radioactivity in the human body also contributes an appreciable dosage. A value of 19 mr./yr. is due to potassium; carbon contributes 1·5 mr./yr., while the minute amount of radium present in the human body produces a dosage of more than 50 mr./yr. It is estimated that the hard gamma rays of potassium contribute about 2 units out of the 19. This leads to the interesting result that in a packed crowd the radioactivity from the potassium in one's neighbours' bodies contributes an additional dosage of 2 mr./yr.

It is found that various ordinary, but somewhat unusual circumstances in normal living produce exposures far in excess of the quantities mentioned above. A wrist watch worn 24 hr./day that has a luminous dial assumed to have 1 microcurie of radium per watch—a figure perhaps slightly larger than the average—would give the central body including the sex organs, a dosage of about 40 mr./yr. An airplane pilot flying a 24-hour-day with an instrument panel consisting of 100 dials with 3 microcuries of radium each would receive, at an average distance of 1 yard, a dosage of 1300 mr./yr.

Dr. Libby has also checked whether the dosages calculated and listed by him are essentially correct by comparing them with some direct measurements reported by various observers. It is interesting that the variations in natural dosage are large, and that under certain conditions the natural dosage may be nearly 100 times higher than the minimum—the dosage of sea-farers. The fallout dosage rate in the United States on 1 Jan. 1955, namely, 1 mr./yr., was only 2% of this lowest natural dosage rate. Of course, during a test period when bombs are fired, the fallout dosage rates may approach, or somewhat exceed, the natural dosage rate for a few days before decay, but weathering processes will reduce them in a few weeks to rates that are small percentages of the natural background.

ATOMIC POWERED X-RAY MACHINES

ATOMIC-POWERED X-ray machines, which require no electric power for operation, developed at the U.S. Army Medical Research Laboratory, Fort Knox, Kentucky, were described at the Geneva Conference on Peaceful Uses of Atomic Energy.

Recent advances have made a 22 lb. unit possible. The new unit is powered by a tiny pellet of radioactive thulium metal, smaller in diameter than a pencil eraser, and only about 2 mm. thick. Thulium is refined into pure metal and then activated in a modern reactor. A small opening in the lead shield permits the rays to come from the machine when a thin gold shutter is released. The rays from the unit are available 24 hours a day and the tiny pellet is good for about one year, after which it can be reactivated in a reactor.

A second type uses radioactive strontium. The beta particles emanating from it are directed toward a metal disc or target, where they are converted to X-rays. Work in this field is presently directed toward designing a machine weighing less than 10 lb. and usable for about 20 years without recharging.

Pictures taken with present atomic X-ray machines are without doubt inferior to those taken with modern X-ray machines that require electric power. However, tests show that the isotopic X-ray machines are good enough at present to locate bone fractures and any foreign bodies such as pieces of metal. Considering the rapid strides that are taking place in atomic research, the future of the atomic X-ray machine looks very promising.

THE INHIBITION BY SULPHANILAMIDE OF THE METABOLISM OF HISTIDINE IN GERMINATING SEEDS

V. M. SIVARAMAKRISHNAN AND P. S. SARMA

University Biochemical Laboratory, Madras-25

THE catabolism of histidine is mediated by the specific enzyme histidase,[1] which occurs in animal livers (especially cat liver), and also in the bacterium *Pseudomonas fluorescens*.[2] The presence of histidase in plants has not been reported. By the action of liver histidase, histidine is hydrolytically decomposed into ammonia, and a product, which on treatment with strong alkali or acid, yields a molecule of glutamic acid, one molecule of formic acid, and one more molecule of ammonia.[1] Thus glutamic acid or a derivative of it, is a product of the decomposition of histidine. Subsequent investigations (reviewed by Tabor[3]) have established urocanic acid, Lα-formamidinoglutaric acid, and N-formyl glutamic acid as intermediates in the conversion of histidine to glutamic acid, formic acid and ammonia.

Since the decomposition of histidine gives rise to formic acid, a single carbon unit, the vitamins, *p*-aminobenzoic acid and folic acid may be expected to take part in the degradation of histidine. Recently, Tabor and collaborators[4] have reported that feeding of histidine to folic acid-deficient rats increases the urinary excretion of a compound, which, on decomposition, gives a molecule each of glutamic acid, formic acid, and ammonia. This compound has now been identified to be α-formamidinoglutaric acid.[5] Our previous investigations[6] have shown that, during germination of greengram seeds (*Phaseolus radiatus*), the addition to the growth medium, of sulphanilamide, an antivitamin for *p*-aminobenzoic acid, produces an accumulation of histidine, due presumably to an inhibition of its catabolism. With the availability of histidine labelled with C^{14} in the α-carbon atom from the Tracerlab Inc., Boston, the degradation of histidine in germinating seeds, its possible conversion to glutamic acid, the inhibition by sulphanilamide of this conversion, and also the quantitative significance of this conversion in the overall metabolism of histidine have been investigated.

EXPERIMENTAL

The experiment consists essentially in germinating greengram seeds with radioactive histidine in the medium, isolating the glutamic acid as the hydrochloride, and histidine as nitranilate from the seedlings, and measuring the radioactivity in them.

25 g. of greengram seeds divided into five 5 g. lots were used for the germination. Each lot, after surface sterilization with 0·1% $HgCl_2$ solution and washing, was allowed to germinate inside a sterile 11 cm. petri dish containing a filter circle, and the sterilized medium. The medium consisted of 1·232 mg. of radioactive histidine, with an activity equal to $4{\cdot}128 \times 10^6$ c.p.m., and sterile water to 24 ml., which is just enough for 72 hr. germination. Germinations were carried out in a sterile chamber in diffuse light for 72 hr. at room temperature, which varied between 28 to 31° C.

Similar germinations with medium containing sulphanilamide also (640 μg./24 ml.) were conducted simultaneously to study the effect of sulphanilamide.

At the end of the germination, the seedlings as well as the petri dishes were washed, and the activity in the collected washings was determined. The seedlings were then hydrolysed with 6 N HCl for 22 hr., the excess HCl was removed by distillation *in vacuo*, the solution was diluted to precipitate out the humin, and then made up to a known volume. A sample of this solution was removed for the estimations of the amino acids, histidine according to Macpherson[7] and glutamic acid according to Meister, Sober and Tice,[8] as well as the total radioactivity after suitable dilution. The rest of the solution was used for the isolations. Carrier histidine (400 mg.) was added to facilitate the isolation of radioactive histidine.

From this solution, glutamic and aspartic acids were precipitated as their barium salts by Foremann-precipitation,[9] and the glutamic acid then separated as the hydrochloride according to conventional procedures given by Block and Bolling.[10] The glutamic acid hydrochloride was purified by repeated reprecipitations to constant activity. From the solution remaining after Foremann-precipitation, the barium was removed as sulphate, the solution acidified strongly with nitric acid, and then excess of silver nitrate solution added. The precipitated silver chloride was removed and the pH of the solution then adjusted to 7·4 with barium hydroxide solution, to precipitate the histidine as the silver salt. The histidine-silver salt was

then converted into pure histidine nitranilate, following closely the details given by Block and Bolling.[10] Radioactivity measurements were carried out with 0·1 mg. samples spread out as uniform thin layers in stainless steel planchets, 2·4 cm. in diam., with a windowless gas-flow counter, connected to an autoscaler and an Eagle Present Counter. All counts were taken with a probable statistical error not exceeding 2%. No corrections were made for self-absorption.

Results and Discussion

Table I

Distribution of radioactivity in greengram seeds germinated with α-C^{14}-labelled histidine in the medium, for 72 hr.

	Control	Sulphanilamide treated
Activity supplied as histidine	$2·064\times10^7$ c.p.m.	$2·064\times10^7$ c.p.m.
Activity in washings ..	Negligible	Negligible
Activity in the hydrolysate	$1·168\times10^7$ c.p.m.	$1·506\times10^7$ c.p.m.
Activity of histidine in the seedlings	$1·164\times10^7$ c.p.m.	$1·424\times10^7$ c.p.m
Degradation of histidine as % of activity supplied	43·6	31·0
Activity in glutamic acid	$3·373\times10^4$ c.p.m.	$2·148\times10^4$ c.p.m.
Activity in glutamic acid as % of total activity	0·1634	0·1041

It will be seen from Table I that, under normal conditions, there is a degradation of histidine to the extent of 43·6% in 72 hr. On the other hand, chemical determinations of histidine in the ungerminated seeds and 72. hr.-germinated seedlings actually point to a net synthesis of histidine to the extent of about 19%. This would mean that, during 72 hours' germination, there is a degradation of histidine by about 43·6%, and a concomitant synthesis of about 62·6%, resulting in the observed net synthesis of 19%. Histidine, then, is in a metabolically active state in germinating seeds. Similar results have been obtained with glutamic acid also.[11] While estimations of glutamic acid in the ungerminated seeds and 72 hr.-germinated seedlings showed a net fall in glutamic acid of only 35%, isotopic investigations revealed a degradation amounting to no less than 95%, pointing to a concomitant synthesis of about 60%, and hence to the high metabolic activity of glutamic acid in germinating seeds. The investigations with these amino acids suggest, that other amino acids too, are probably in a metabolically active state, undergoing both degradation and synthesis at the same time.

The glutamic acid isolated has been found to be radioactive. Thus, there is a conversion of histidine to glutamic acid in plants also, even as in animals[1] and bacteria.[2] When sulphanilamide is added to the medium, there is a greater retention of radioactivity, and a lesser degradation of histidine. Sulphanilamide, thus, inhibits the catabolism of histidine. At the same time, there is a decrease in the radioactivity of glutamic acid. This suggests that sulphanilamide inhibits the conversion of histidine to glutamic acid.

While this conversion seems to be an established one, a comparison of the activities in histidine and glutamic acid throws doubt as to the importance of this conversion as a major pathway of histidine metabolism in this species. A loss of 43·6% of the total activity in histidine is accompanied by a gain in glutamic acid of only 0·1634%. An accumulation of 12·6% of total activity in histidine by sulphanilamide inhibition is accompanied by a loss of only 0·0593% of total activity in glutamic acid. Thus, the changes in the radioactivity of glutamic acid are only minor fractions of the changes in the activity of histidine. As such, this conversion does not seem to be a major pathway in the metabolism of histidine, even when due allowance is made for the rapid catabolism of glutamic acid during germination.[11]

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LETTERS TO THE EDITOR

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DETERMINATION OF ULTRASONIC VELOCITY IN SOME COMPLEX CHLORIDES OF MERCURY

A number of workers[1-6] have shown that when solutions of $HgCl_2$ and KCl are mixed in different proportions, then complexes are formed if the ratio of the number of molecules of the two are as 1 : 1 or 1 : 2 or 2 : 1. In particular, the formation of the compound K_2HgCl_4, and the occurrence of the ion $HgCl_4^{--}$ have been definitely established. Evidence for the formation of the ion $HgCl_3^-$ has been obtained from surface tension,[2] Raman spectra[3] and solubility measurements.[4,5] In the present note, ultrasonic data are presented which confirm the existence of the ion $HgCl_3^-$.

Ultrasonic velocities were measured at 29° C. for the solution corresponding to the concentrations mentioned in Table I. All the solutions contained 20 g. of $HgCl_2$ in 250 ml. of solutions, while the concentration of KCl is as given in column 1.

Table I

Amount of KCl in g.	Ratio of number of molecules KCl : $HgCl_2$	Velocity metres/sec.
0·00	0 : 1	1484·9
2·75	½ : 1	1488·9
5·50	1 : 1	1490·6
8·25	1½ : 1	1495·7
11·00	2 : 1	1501·2

On drawing a graph between the measured velocity and the corresponding amount of KCl added we do not get a uniform increase in

velocity, but there is a clear discontinuity in the curve at KCl. $HgCl_2$ as shown in Fig. 1.

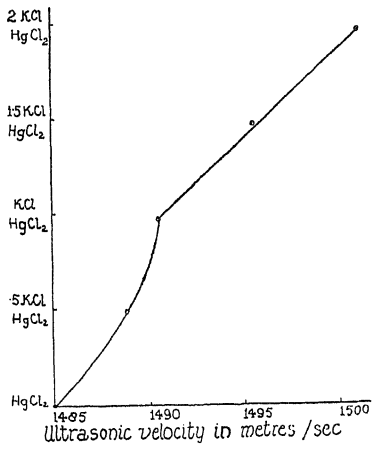


FIG. 1

This suggests the formation of a new compound in a solution of KCl. $HgCl_2$ yielding the ion $HgCl_3^-$. The detailed paper will be published elsewhere.

Physics Department, J. R. SARAF.
Lucknow University, P. N. SHARMA.
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THE IMPORTANCE OF THE POINT OF INFLECTION IN THE VISCOSITY-TIME CURVE OF THE SLOW COAGULATION OF COLLOIDS

IT has been clearly observed that under ordinary conditions the rate of slow coagulation has an autocatalytic character with most coagulators and the viscosity-time curves are therefore S-shaped. While studying the kinetics of slow coagulation of As_2S_3 sol, it has been observed that the points of inflection ($d^2x/dt^2 = 0$) in the viscosity-time curves obtained by adding different concentrations of the electrolyte are significant because they denote the same kinetic state in the process of coagulation. Hence these points may be considered to be governed by the same state of the size, shape and charge of the aggregated particles. In other words, the times corresponding to the points of inflection may be reasonably assumed to be such as to give the same stage of coagulation attained by adding different concentrations of the electrolyte.

In previous communications,[1] the relation between the time of coagulation t and the concentration C of the electrolyte was expressed by the equation,

$$C = a + \frac{m/t}{(n + 1/t)}$$

where a, m and n are constants. This equation can be reduced to the form

$$\frac{1}{C - a} = \frac{n}{m}\, t + \frac{1}{m}$$

where $1/(C - a)$ is linear with t.

The degree of coagulation was determined by measuring the relative change of viscosity given by $(T - T_0)/T_0$ where T_0 is the time of efflux without adding the coagulating electrolyte and T is the time of efflux after the addition of electrolyte at different time intervals. $(T - T_0)/T_0$ was then plotted against the corresponding time intervals for different concentrations of electrolyte, and the points of inflection were then determined from the curves as shown in Fig. 1. The reciprocal of the different times

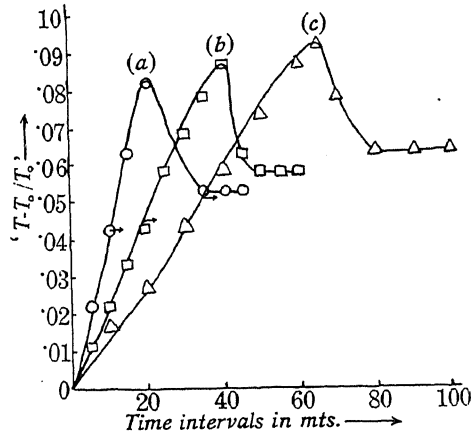


FIG. 1. Concentration of the As_2S_3 Sol—0·09 M,
Curve (a) → Electrolyte Concn. = 0·45 M
Curve (b) → Electrolyte Concn. = 0·45 M
Curve (c) → Electrolyte Concn. = 3·45 M

($1/t$) corresponding to the points of inflection obtained from the degree of coagulation and time curves of the As_2S_3 sol were plotted against the respective concentrations (C) of the electrolyte (KCl) used. The intercept obtained on the C-axis gave the value of the constant a, *i.e.*, when $1/t = 0$ (see Fig. 2). Knowing a, $1/(C - a)$ was plotted against t and the curve was found to be linear, which confirms the

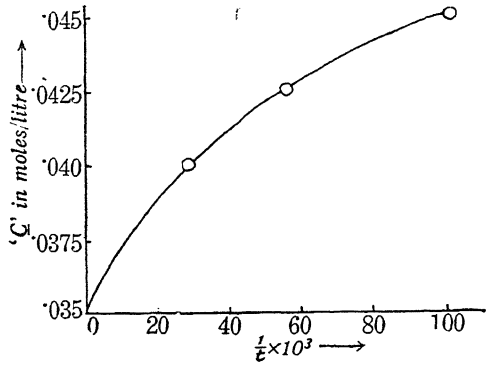


FIG. 2

validity of the new equation (Fig. 3). The constants m and n can also be determined gra-

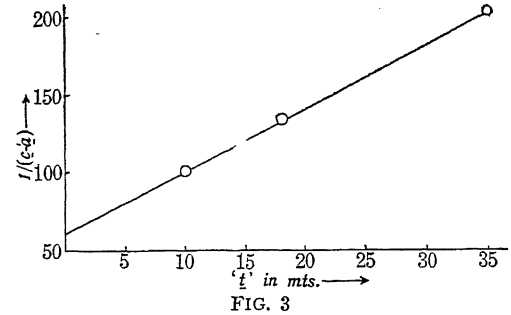


FIG. 3

phically as was explained in previous communications (*loc. cit.*).

The detailed data will be published elsewhere.

Grateful thanks are due to Prof. A. K. Bhattacharya, for his valuable suggestions in these investigations.

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Agra College, Agra,
March 7, 1955.

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POTENTIOMETRIC TITRATION OF AROMATIC AMINES WITH SODIUM NITRITE

MULLER AND DASCHELT[1] applied the potentiometric method to the titration of aromatic primary amines in acid solution with sodium nitrite. Concentrated solutions were used by them for the purpose and the influence of the acid concentration on the inflection potential was not investigated. Kolthoff[2] attempted to apply the method in the case of dilute solutions but without success. A complete investigation was therefore carried out.

The titration cell consisted of the same Muller electrodes[1] and a saturated potassium chloride salt bridge was used to eliminate the liquid junction potential. A Cambridge Vernier Potentiometer was used in all titrations and the null point was detected by a ballistic galvanometer with lamp and scale arrangement. A micro-burette and an ordinary glass stirrer were used in all experiments. Hydrochloric acid (sp. gr. 1·16) and sodium nitrite solutions of suitable higher concentration were used in all the titrations.

The influence of amine concentration, investigated in the case of aniline at 19° C., is shown in Table I.

TABLE I

Strength of aniline solution		Aniline by expt.	Percentage error
in Molarity	in g./litre	g./litre	
0·0645	6·377	6·235	0·7
0·1075	11·181	11·117	0·6
0·1613	14·364	14·392	0·2
0·2150	20·510	20·510	0·0
0·3225	30·730	30·700	0·1
0·5376	50·643	50·752	0·2
0·6850	60·527	60·688	0·3
0·8600	80·191	80·487	0·4

It is evident from Table I that amine solutions of strength about M/4 can be accurately titrated with sodium nitrite solutions about 10 times more concentrated than the amine solutions.

The influence of the hydrochloric acid concentration, studied for the first time, is shown in Table II for p-toluidine.

TABLE II

S. No.	Hydrochloric acid (sp. gr. 1·16) present in 25 ml. of p-toluidine solution in g.	Inflection in potential at equivalence point (mV)
1	2·915	39
2	4·935	46
3	7·155	85
4	9·275	86
5	11·395	90

It is seen from Table II that about 8 g. of hydrochloric acid (sp. gr. 1·16) should be present in 25 ml. of the titrating solution to obtain the maximum rise in potential at the equivalence point, whereas Muller and Daschelt used only half this amount of acid for the same volume of solution.

The influence of temperature was also investigated and these titrations gave accurate results below 20° C.

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SINGLE VALVE SAW TOOTH GENERATOR

One of the relaxation oscillators, a blocking oscillator,[3] can be used as a saw tooth generator to display the time base[1] on the cathode ray tubescreen. If the screen coupled blocking oscillator is operated on sinh-sin mode of operation, then the circuit is capable of giving a sawtooth waveform.

Fig. 1 shows a circuitry which produces a saw tooth waveform. The repetition rate is

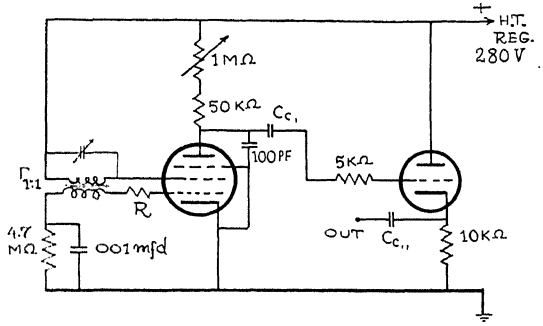


Fig. 1

determined by the primary inductance and the stray capacitance, which is approximately equal to $W^2/L_P c$ and the pulse length is given by,

$$T = \frac{\pi C \sqrt{L_P}}{\sqrt{C - g^2 L_P}}.$$

where g = mutual conductance, C = stray capacitance, L_P = primary inductance.

Principally, the circuit drawn in Fig. 1 can be considered as a tight-coupled Hartley type oscillator, but in this case the screen grid is coupled to the control grid instead of anode.

When the H.T. is switched on, a certain amount of potential is developed across the screen winding of the transformer, this potential drop at the screen is inverted in the control grid winding, such that the control grid becomes positive, which causes a further increment in the total current and the current drawn by the screen. During the whole operation, the anode is kept at very low potential and therefore it has very little influence on the behaviour of the circuit. The feed-back as described above is sufficient to cause the first half-cycle of the oscillation to take place. The period of oscillation is determined by the transformer inductance and stray capacitance present. Due to the presence of the limiting resistor R, the resulting voltage at the control grid is such that the operation does not extend well into the non-linear region of the tube characteristic and therefore the flattened half of the sinusoidal current is not produced, as a result of that the sinusoidd alwaveform is present at the control grid (Fig. 2).

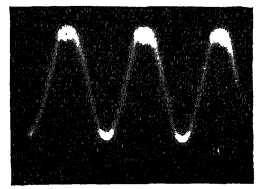


Fig. 2

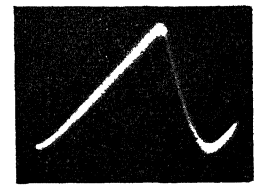


Fig. 3

When the sine pulse rises from negative peak towards the zero potential, then to the positive maximum, it charges the capacity, which ultimately results into a linear saw tooth waveform at the anode (Fig. 3).

Though the design of the transformer determines the pulse length and the operation, still it is not free from the associated circuit components. The sweep duration can be varied by connecting a variable capacitor across the primary of the transformer or can also be varied by altering the gain of the tube. The general requirements and the design of the transformer do not differ much from the design data given by Benjamin.[2] If the circuit parameters are carefully chosen and the design of the transformer is within the specified values, the pulse length and the repetition rate can be predicted with fair accuracy.

The circuit given in Fig. 1 provides a free running sweep, the repetition frequency of which can be varied from 47 kc/s. to 59 kc/s. Available sweep at the output point is of 50 μ sec. duration approximately.

The experimental circuit described above, can be used where cheapness and fairly good accuracy is required. It can also be used for general purpose; the available frequency range is increased by having a transformer with a number of tappings in the primary and second-

ary and only one pair (turns ratio 1 : 1) is connected at a time in the circuit. With the help of this arrangement one can vary the sweep frequency from 30 kc/s. to 115 kc/s.

My thanks are due to Dr. K. K. Bose for his guidance.

Dept. of Electronics, V. V. R. INDULKAR.
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THERMODYNAMICS OF COPPER-NICKEL ALLOYS

IN recent years increasing attention has been paid to phase-diagrams for yielding useful thermodynamic data.[1] Particularly, eutectic systems have been analyzed and heat and entropy of mixing computed.[2] In spite of some of the recent developments in calorimetric technique,[3] indirect methods have to be developed for estimating heat of mixing at higher temperatures and the same for solid alloys. Apart from its thermodynamic value, heat of mixing can throw valuable light on the nature of metallic bond in solid alloys. Accordingly we give below a method for computing heat of mixing of solid and liquid alloys from phase-diagrams of metallic systems forming complete series of solid solutions.

It has been experimentally observed that for a large number of non-ideal mixtures, heat of mixing can be represented by an equation of the following form[4,5]

$$H_M = N_1N_2 [A + B (N_1 - N_2) + C(N_1 - N_2)^2 + \cdots]$$

where A, B, C....are empirical constants. Using Gibbs' method[6,7] the equations for the slopes of solidus and liquidus curves can be readily deduced by assuming the above equation for heat of mixing. Assuming the heat of mixing to be temperature independent which is not an uncommon feature in metallic systems, the values of the constants can be determined from the observed slopes by the method of least squares.

In this connection copper-nickel system was re-examined which had been previously investigated by Seltz[8] who calculated the solidus and liquidus curves from temperature and heat of fusion of respective pure components, assuming the solid as well liquid phase to behave ideally. *Prima facie,* this assumption does not seem to be incorrect since the molar volumes of the two components in the two phases are approximately similar and the atomic arrangement in the crystal lattice is almost identical. In view of the specific nature of metallic bond,[9] it is not proper to assume that such mixtures are ideal or regular. The solid phase would be regular in extremely rare cases, while the liquid phase may approximate to regular behaviour in a few cases. These conclusions are corroborated by the heat of mixing calculated according to above procedure with the help of observed solid-liquid equilibrium data.[10] It is found that the heat of mixing for the two phases are given by the following expressions :

$$H_M \text{ (for solid phase)} = N_1N_2 [-1806 - 43030 (N_1 - N_2) - 49890 (N_1 - N_2)^2]$$

$$H_M \text{ (for liquid phase)} = -5144\ N_1N_2$$

where N_1 and N_2 are the mole-fractions of the respective components in the specific phase. The form of the equation for liquid phase conforms to that for a regular mixture. In Fig. 1 the relationship between heat of mixing of solid alloys of different compositions and its Brinell's hardness has been indicated since both the properties depend essentially on the binding energies of the alloys. The predominantly negative heat of mixing in nickel-rich alloys is in agreement with the existence of λ-point in the specific-heat-temperature curves of such alloys.

Other metallic systems are being investigated in order to throw light on the nature of metallic bond and the detailed paper will be published elsewhere.

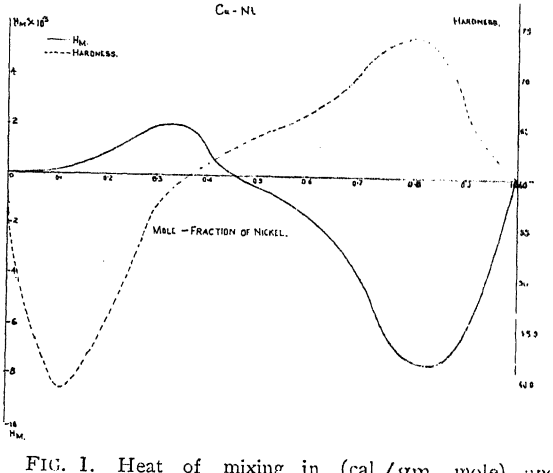


FIG. 1. Heat of mixing in (cal./gm. mole) and Brinell's hardness of Copper-Nickel alloys.

One of us (K. T. R. V.) is thankful to Council of Scientific and Industrial Research for a maintenance grant.

Chemistry Department, Lucknow University, April 15, 1955.

R. P. RASTOGI.
K. T. RAMA VARMA.

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VAPOUR PHASE CHLORINATION OF ETHANOL UNDER SILENT ELECTRIC DISCHARGE

LIQUID phase chlorination of ethanol is commercially exploited for the manufacture of chloral, but no work has been reported in the vapour phase. The present investigation was carried out under the latter conditions, under the influence of electrical excitation.

Streaming chlorine at 6 ml./sec. mixed with alcohol vapour raised at 65-70° C. from commercial rectified spirit was passed through a Siemens' type all-glass ozonizer excited by 50 cycles A.C. potential of the order 3-8 KV. The less volatile products condensed on the walls of the ozonizer and eventually trickled down in the alcohol-feeding flask; the volatiles were carried over by the effluent gases and condensed in a receiver cooled with freezing mixture.

The condensate, in its less volatile part, was found to contain H^+ and Cl^- ions and quantities, the relative proportions of which varied with duration of discharge and other factors such as applied potential, etc., of chloral, dichloro-acetaldehyde and dichloro-acetaldehyde-acetal with small amounts of chloral alcoholate. In the volatile fraction, besides the smaller quantities of above products, paraldehyde was found in appreciable quantity.

Working with 50 ml. of rectified spirit for every run of 2 hours discharge, 10-15 g. of dichloro-acetaldehyde acetal were obtained, the formation of which appears to be favoured by higher applied potentials. The total of chloral and dichloro-acetaldehyde formed ranges from 8-15 g.; for want of an adequate technique of separating and differentially estimating them, it has not been possible so far to determine exact proportions of these in the mixture. The Cl^- and H^+ ions formed are almost in equivalent proportions indicating the absence of appreciable amounts of other acidic products.

Compared with the results of vapour phase chlorination carried out independently but without the application of silent electrical discharge, the quantities obtained are very large, indicating thereby the remarkable role played by the electric discharge. It has been observed further that the yield of any one or more products can be selectively controlled by an appropriate adjustment of the operative electrical factors.

Further work is in progress to explore the possibilities of the reaction and the mechanism of chlorination.

Sincere thanks of the authors are due to Principal S. S. Joshi for his kind interest, and to Dr. R. H. Sahasrabudhe for criticism and useful suggestions.

Dept. of Chemistry, Banaras Hindu University, Banaras, *August* 9, 1955.

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CONSTITUTION OF MAXIMA SUBSTANCE B

THE isolation of a substance designated as Maxima substance B, m.p. 126-28°, from the roots of *Tephrosia maxima* Aers. was reported in a recent note published from these laboratories.[1] The composition of the substance corresponds to the formula $C_{21}H_{18}O_5$. This formula is based upon the degradations described herein and some others not recorded here and it supersedes the formula suggested provisionally in the earlier communication. It is neutral in character, being insoluble in aq. sodium hydroxide and giving no colour with ferric chloride. It contains no methoxyl but it gives a positive test for the methylenedioxy group. Hydrolysis with 12% aqueous sodium hydroxide gives formic acid (qualitative reactions) and piperonylic acid (mixed m.p.), proving its nature as an isoflavone with a methylenedioxy group in the 3′ : 4′-positions of the side phenyl nucleus. Treatment of Maxima Substance B with methanolic hydrogen chloride or glacial acetic acid-sulphuric acid yielded a hydroxy compound, whose properties including hydrolysis with 12% aq. sodium hydroxide and those of its acetate

and ethyl ether indicated its probable identity with the natural isoflavone pseudobaptigenin. This identity was established by a direct comparison of the ketone obtained by alkaline hydrolysis with synthetic pseudobaptigenetin and of the main phenolic compound itself with synthetic pseudobaptigenin.

The formation of pseudobaptigenin (phenolic) from the non-phenolic Maxima Substance B under the influence of methanolic hydrogen chloride or acetic-sulphuric acids is to be explained by assuming that Maxima Substance B is a 7-0-alkyl ether of pseudobaptigenin, which undergoes dealkylation under the influence of these reagents. That the alkyl residue is most probably $(CH_3)_2C=CH\text{-}CH_2\text{-}$ is indicated by a comparison of the molecular formulæ of Maxima Substance B and pseudobaptigenin, by the formation of acetone (identified through the dinitrophenylhydrazone) on oxidising Maxima Substance B with chromic acid and from general biogenetic considerations and analogy with other well-known natural products.

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Dept. of Pharmacy,
Andhra University, Waltair,
May 21, 1955.

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ACTIVE RELAXATION OF UNSTRIATED MUSCLE PRODUCED BY PROTEOLYTIC ENZYMES

THE transverse muscle of the stomach of the frog (*Rana tigrina*) has the interesting property that its contractile mechanism is actively relaxed by substances that denature proteins.[1-4] According to modern views, denaturation consists of an alteration of the specific internal structure of the protein wherein the closely folded peptide chains unfold.[5] Similarly, the contraction of muscle is supposed to be due to folding of the contractile protein; so relaxation would be due to unfolding of the muscle proteins. The process of reaxation of muscle would be similar to the denaturation of proteins.

In the mechanism of enzymatic hydrolysis, it is presumed that the first phase of the enzymatic action is the combination of the enzyme with its substrate; the second phase of the enzymatic hydrolysis is the hydrolytic cleavage of the substrate while it is bound to the enzyme forming a complex. The formation of this complex loosens probably some bonds of the substrate so that the enzyme is then able to act. The polypeptide chains might be at first unfolded and then undergo hydrolytic cleavage.

The unfolding action of the proteolytic enzymes can be tested on the heat-killed frog's stomach muscle. Experiments were performed on unloaded strips of circular muscle of the stomach of the frog, *Rana tigrina*. Both dying muscles and heat-killed muscles were used. The muscles were killed by heating to 50° C. for 10 minutes. They were then treated with various concentrations (0·2 to 1%) of enzymes: trypsin, pepsin and papain. The enzymes were dissolved in frog saline, and the pH was adjusted to the requisite value, 8 for trypsin, 1-2 for pepsin, and 1 or 6-7 for papain. The control muscles were immersed in saline containing boiled enzymes; trypsin and pepsin were boiled for 10 minutes and papain for 15 or 20 minutes. The enzymes were allowed to act for 24 hours at 37° C.

The action of trypsin was most satisfactory. In 41 experiments it caused active relaxation of the heat-killed muscle by 13 to 70%. In 3 experiments it had no action, and in 3 other experiments it caused contraction. The concentration of the enzyme has to be suitably adjusted so as to be mild, as contraction appears to occur at the hydrolytic stage, and active relaxation as a preliminary effect. Pepsin did not produce any relaxation, but the acid medium actively relaxed some muscles. It appears, therefore, that pepsin requires the acid medium for the preliminary unfolding action of the latter. Papain also caused active relaxation from 10 to 38%. Dying muscles were also relaxed by trypsin.

These experiments therefore indicate that hydrolysis of proteins by enzymes is preceded by unfolding of the polypeptide chains. This might be done by the enzyme itself, or by the medium in which the enzyme acts.

Dept. of Physiology, SUNITA INDERJIT SINGH.
Medical College, INDERJIT SINGH.
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AMINO ACIDS IN THE RESERVE NUTRITIVE MATERIAL OF THE EGG OF *PILA VIRENS* (LAMARCK)

In recent years the technique of paper chromatography has been employed to study the embryonic development of animals in relation to changes in the amino acid composition in developing tissues and in the reserve substances in the eggs. But so far only the eggs of the sea urchin (Berg[1]) and a few other invertebrate eggs (Holtfreter *et al.*[5]) have been investigated.

As a preliminary study in the chemical embryology of *Pila virens*, a qualitative determination of the utilisation of the amino acids of the albuminous material surrounding the embryo was carried out. The embryo of *Pila*, as Ranjah[7] and Nagaraja[6] have shown, is surrounded by an albuminous fluid, bounded by a thick 'albumen' layer, the two together being usually termed 'albumen' in zoological literature. The albuminous fluid and the solid 'albumen' constitute the reserve nutritive material for the developing embryo. The present note records the more important features in the utilisation of the free amino acids as well as those of the hydrolysates of this reserve material.

For the preparation of the hydrolysates, the procedure described by Giri *et al.*[4] was adopted, and for the determination of the free amino acids the method described by Block.[2] The amino acids were identified using the circular paper chromatographic technique by running mixed chromatograms and by spotting the known and unknown in the same chromatogram.

At the commencement of development in the freshly laid egg there are altogether 18 amino acids in the hydrolysate of the reserve food material, 9 of which appear as distinct bands and the remaining have overlapping bands (Fig. 1). Amino acids having very nearly the same R_f values do not separate into distinct bands as in the case of bands 1, 2, 7 and 8 in the chromatogram shown in Fig. 1. "Multiple development technique" as described by Giri and Rao,[3] however, gave better separation of the overlapping amino acids.

The sequence of disappearance of some of the amino acids in the hydrolysate obtained from the food material during development is as follows: 8-cell stage—proline; 16-cell stage—cystine; 32-cell stage—arginine, serine, proline and cystine; gastrula stage—only alanine, glutamic acid; threonine, glycine and histidine could be identified with certainty and they too are in low concentration, appearing as rather faint bands in the chromatogram. By the trochophore stage, when the organogenesis of the embryo commences, the amino acid content of the hydrolysates of the reserve food material becomes too low in concentration to permit a clear chromatographic analysis.

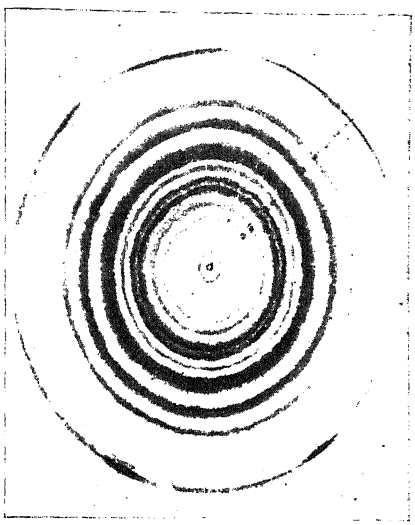


FIG. 1. Circular paper chromatogram of reserve food material hydrolysate in the freshly laid egg.

1. Leucine + Isoleucine; 2. Phenylalanine; 3. Valine + Methionine 4. Tyrosine; 5. Proline; 6. Alanine 7. Threonine + Glutamic acid; 8. Glycine + Serine + Aspartic acid, 9. Asparagine; 10. Arginine; 11. Histidine; 12. Ornithine; 13. Cystine.

For the determination of the free amino acids in the reserve food material six stages were examined, *viz.*, (1) fertilized egg, (2) 2-cell stage, (3) 32-cell stage, (4) blastula, (5) gastrula, and (6) trochophore. The initial stage showed the presence of alanine, glutamic acid, glycine, histidine and arginine. Glycine is the only free amino acid present in good concentration in all the stages. Arginine is present only in the initial stage of the fertilized egg, being absent in all subsequent stages. Glutamic acid disappears in the trochopore stage. Alanine and histidine are present in low concentration in all the stages. Table I shows the distribu-

Stage	Amino acids				
	Alanine	Glutamic acid	Glycine	Histidine	Arginine
Fertilized egg ..	F	F	I	F	F
2-cell stage ..	F	F	I	F	..
32-cell stage ..	VF	VF	I	F	..
Blastula ..	F	F	I	F	..
Gastrula ..	F	F	I	F	..
Trochophore ..	F	..	I	F	..

F, faint; VF, very faint; I, intense.

tion of the free amino acids in the reserve food material during development.

The significance of the above findings in relation to morphogenesis is under investigation. My thanks are due to Prof. R. V. Seshaiya for suggesting the problem, and for guidance and instruction, and to the Government of India for the award of a senior research scholarship.

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CEREBROSPINAL NEMATODIASIS AMONG BOVINES IN SOME MALNAD TRACTS OF MYSORE STATE

AN obscure disease among cattle characterised by paraplegic or complete paralytic symptoms is prevalent since several years as seasonal enzootic in Hosnagar, Sagar and Sorab taluks of Shimoga District, Mysore State, bordering South and North Kanara Districts of Madras and Bombay States respectively. Bovine paralysis in South Kanara District with exactly similar symptoms was observed by Viswanathan (quoted by Ramakrishnan and Ananthapadmanabhan[8]) and a similar disease among cattle and buffaloes in North Kanara District was reported by Kulkarni.[6] Enzootic bovine paraplegia in Mysore State is non-febrile and occurs in acute, subacute and chronic forms. In acute cases the onset of complete paralysis is sudden and death results in about 2-3 days, while in subacute and chronic cases the disease starts with immobility of tail and paraplegia followed by gradual progressive paralysis of the anterior parts and the course extends from a week to a month or even more.

Microscopic, cultural and biological tests with blood, cerebrospinal fluid, emulsions of spleen, brain and spinal cord did not reveal any specific bacterium, virus or protozoan parasite. The possibility of latent trypanosomiasis, nutritional deficiency, particularly of calcium, phosphorus and magnesium was also ruled out. The spinal cord and brain from four typical cases of bovine paraplegia (2 acute and 2 subacute) were removed after *post-mortem* examination conducted within 3 hours after death and preserved in 10% formalin. After 48 hours of preservation the tissues were taken out for embedding and sectioning and the formalin which had become turbid was centrifuged. The sediment was examined for nematode larvæ as suggested by Niimi (quoted by Innes[2]). Microscopic examination of the nervous tissue sediment obtained after centrifugation of the fixative which contained the brain and spinal cord of two acute cases revealed four complete microfilaria and in the thick smears made from the emulsion of the softened portion of spinal cord and brain, stained with Hæmotoxylin Eosin and Giemsa's stains, bits of microfilariæ were found. All these larvæ were sheathed. Among four complete microfilariæ observed, the largest one (Fig. 1) measured 850 μ in length and 25 μ thick at the head end and the smallest one measured 300 μ in length.

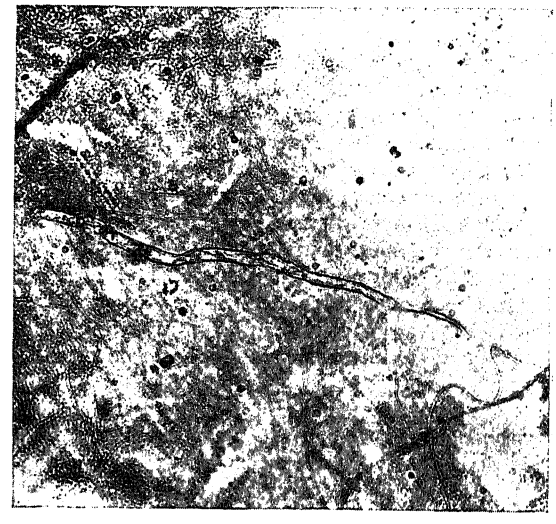


FIG. 1. Nematode larva found in the spinal cord of a cow, acute case of bovine paraplegia (larva found in the tissue sediment got by centrifugation of the lumbar portion of the spinal cord of Case No. 1), ×48.

Histological sections of the brain and spinal cord in 3 out of 4 cases had the following lesions. There was acute softening in which not only the myelin degeneration was present but also the gound substance was loosened and destroyed. Focal cellular infiltration, liquefaction, micro-cavitation and definite changes in axis cylinders such as swollen scanty, disordered and irregularly globose axis cylinders within the transversely cut tube representing myelin sheath were observed in H.E. stained

sections. On the whole the histological picture of the spinal cord in three of the four cases, resembled the lesions of focal liquefactive encephalomyelomalacia as described by Innes.[1] The most important finding was the detection of sections of immature nematodes other than microfilaria in the lumbar portion of the spinal cord of two acute cases. Definite identification of the nematode, whose microfilariæ and immature forms were observed in the spinal cord, was not possible. In the endemic area of Mysore State where bovine paraplegia is prevalent, a large number of blood-sucking flies are found and further investigations on the possibility of some 'blood-sucking insect being involved in transmission of the infective larvæ is under way.

This is the first record of cerebrospinal nematodiasis among bovines. Previously, it has been found in other domestic animals by various workers.[2–5,7]

I am thankful to Dr. P. M. Narainswamy Naidu, for guidance and to Dr. N. S. Krishna Rao for confirming my findings.

Mysore Serum Inst., Hebbal, Bangalore, *August* 5, 1955. SYED MOHIYUDDEEN.

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SUCCINIC DEHYDROGENASE IN THE NEUROSECRETORY CELLS OF THE THORACIC GANGLION OF THE CRAB

THREE types of neurosecretory cells, designated A, B and C, have been described in the thoracic ganglion of the crab *Paratelphusa hydrodromous* (Herbst.) by Parameswaran,[1] based on their histological differences and size. While studying the physiology and structure of these cells, it was observed that the A and B types of cells contain succinic dehydrogenase.

Thin slices of tissue were prepared with a sharp blade from freshly dissected thoracic ganglion. After a rapid wash in distilled water, the slices were placed in incubating media and kept at 37° C. Control sections were treated with sodium malonate added to the incubating mixture. Shelton and Schneider's method using neotetrazolium and Seligman and Rutenberg's method using blue tetrazolium (Pearse[2]) were employed. By both techniques, no indication of succinic dehydrogenase was demonstrable in the C-type of cells. B-Cells always showed a general presence of the enzyme in their cytoplasm. In A-Cells the picture appeared to be somewhat variable. The cytoplasm in many cells show finely distributed and dense granular localisations of the enzyme, but in certain cases they were comparatively few and in other cases they were practically wanting. When abundant, the presence of diformazan (according to Seligman and Rutenberg's technique) granules appear bright blue with a shade of violet (Fig. 1). When the enzyme content was lower, besides some diformazan there was a large number of red monoformazan granules which indicate the low dehydrogenase activity. Probably this difference in the reactions of A-cells may be due to the nature and amount of secretory material in these large neurons.

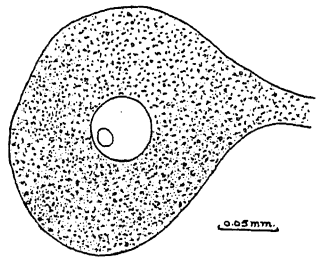


FIG. 1

The slices with A-type of cells become coloured in about 5 minutes when treated according to Shelton and Schneider's method. The rapidity of development of colour is suggestive of the higher enzyme content of these cells.

The cyclical development of succinic dehydrogenase in the A-Cells suggests a probable significance of these cells in the regulation of metabolism of the crab. Matsumoto[3] has recently announced the chromatophorotropic activity of the B-Cells of the thoracic ganglion of the crab *Eriocheir japonicus*; nothing is known about any of the functions of the other cells.

We are grateful to Prof. C. M. Francis, Medical College, Trivandrum, for the gift of the tetrazoliums, and Prof. R. V. Seshaiya, Annamalai University, for the gift of succinate.

Dept. of Zoology, University College, Trivandrum, *May* 7, 1955. K. K. NAYAR. R. PARAMESWARAN.

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CRUSTACEANS IN RELATION TO UNDERWATER TIMBER STRUCTURES

VERY little is known of Indian crustacean borers whereas wood-boring crustaceans of other countries have been studied by several authors like Calman,[1-3] Johnson,[4] Menzis and Mohr.[5] Hence a survey of the crustaceans (isopods and amphipods) in association with submerged timber piles, pillars and catamarans of the Madras coast was undertaken.

The following eight species—the sphæromids, *Sphœroma vastator* sp. Bate, *S. walkeri* Stebbing and *Exosphœroma* sp.; the oniscids *Metoponorthus pruinosus* Brandt, *Oniscus asellus* Linnæus and *Porcellio scaber* Latreille; the armadillid *Armadillidium vulgare* Latreille and the ligid *Ligia exotica* Roux have been found to bore into wood. Nine other species of Crustacea found in association with underwater timber structures are probably only foulers, and may not be harmful to timber. Though they are treated as foulers, they are not sessile as true foulers are. These are the sphæromid *Cilicœa latreilli* Leach; the cirolanids, *Cirolana pleonastica* Stebbing, *C. elongata* M.Ed.; the idotheids, *Idothea gracillima* Dana, *Synidotea variegata* Collinge; the amphipods, *Stenothœ gallensis* Walker of stenothoid; the gammarid, *Elasmopus pectenicrus* Bate; the corophiid, *Corophium madrasensis* Nair and the caprellid, *Protogeton* sp.

The borers reported from the temperate waters, *Sphœroma destructor* Richardson, *S. peruvianum* Richardson, *Limnoria lignorum* Rathke, *Chelura terebrans* Phil. are not found in the Madras waters. The most important borers of the Madras coast are *Sphœroma vastator, S. walkeri, Exosphœroma* sp. and *Metoponorthus pruinosus* which cause extensive damage to wooden structures made out of *Tectona grandis* (Teak), *Mangifera indica* (Mango), *Xylia xylocarpa* (Irul), *Cedrella* sp. (Red cedar) and *Terminalia* sp. These timbers are extensively used in jetties and catamarans. The abundance of these in infested timbers may be gauged from the fact that as many as 100 individuals of all ages can be collected in one cubic inch of wood. *Sphœroma vastator* and *S. walkeri* measure about 10·5 mm. in length with uniform grey colour and differ in the nature of the telson and mandibles. The young ones resemble the adults except in size and colour, being white. Their propagation is so great that as many as 25 to 30 juveniles can be collected from a single brood-pouch. The holes excavated in the wood measure about 13 mm. deep and 3 mm. in diameter. In a single hole more than one may be found huddled together. *S. walkeri* has been reported from Visakhapatnam harbour.[6] *Exosphœroma* sp. resembles *E. yucatanum* Richardson, but differs from it and other established species and a fuller account of this, which is probably a new one, will be given elsewhere.

The oniscid-borer, *Metoponorthus pruinosus*, occurs abundantly in the crevices of catamarans which are frequently drawn ashore for drying. It measures about 8 mm. in length with flattened body and the abdomen abruptly narrower than the thorax. This has also been reported from Visakhapatnam.

The ligid, *Ligia exotica*, is black, about 30 mm. in length, which has developed a marine and wood-boring habitat. The other borers were collected from wooden pieces washed off on the shores at Portonovo, Negapatam and Tuticorin beaches. All the foulers except *Cilicœa latreillii*, occur abundanty in the Madras harbour along with borers and other sedentary organisms.

I thank Prof. C. P. Gnanamuthu for his suggestion and guidance in carrying out this work.

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FLOWERING OF *VOLVOX* IN A FRESH-WATER LAKE IN LUCKNOW, INDIA

IN the course of investigations on fresh-water plankton of Uttar Pradesh, we observed a sudden flowering of *Volvox* in the months of July and August 1954. Observations on flowering and disappearance of plankton species have been recorded by past workers in India, but they deal only with marine forms. On the other hand, publications on *Volvox* in India, by some leading algologists such as Apte,[1] Carter,[2] Iyengar[3] and others, are confined mainly to South India, although Rao[4] made some observations on *Volvox* species from shallow rain-water pools in Lucknow. But no quantitative data on *Volvox* as a component of fresh-water plankton are available, nor are any data available regarding flowering, fluctuations and peak periods. *Volvox* was obtained in our routine plankton hauls, collected early in the

morning, with the help of a half-meter Nansen plankton net. Plankton samples were fractionated by means of Lea-Gibbon's subsampler and the required part was transferred to the counting slide under the binocular microscope and, after numerical counts were made, the percentage of each organism was calculated.

The outburst of *Volvox* was noticed in the last week of July, and the crop was at its bloom for about 2 weeks, the water being light green in colour during this peak period. The species has been identified as *Volvox carteri* Stein, and our collections contain the various developmental and life-history stages of the species. The percentage composition of the plankton was determined by us, and the percentage of *Volvox* was found nearly constant in the last week of July and the first week of August. There was, however, a gradual decline during the rest of August. In September (Fig. 1) there was a sudden fall in the percentage composition, and the number of *Volvox* decreased considerably in the month of October and November till there was a total disappearance of the crop in the month of December. The other components of the plankton were copepods, cladocera, crustacean larvæ, insect larvæ, rotifers and statoblasts of bryozoa; but crustaceans were in a majority.

It is quite evident from our observations that the *Volvox* crop was at its peak for about 2 weeks, during the last week of July and the first week of August. The entire period of maximum occurrence of *Volvox carteri* Stein can be stated to be from July to September. The water of the lake was not green throughout this period, excepting for the two weeks in July and August.

Besides this, it has been observed that the amount of *Volvox* by volume and weight, as also on percentage basis, appears to vary inversely with the amount of crustaceans from the same lake (Fig. 2). It would appear that this is the first record of an inverse correlation between *Volvox* (phytoplankton) and crustaceans (zooplankton) in fresh-water plankton in India.

Dept. of Zoology, S. M. Das.
University of Lucknow, V. K. Srivastava.
April 16, 1955.

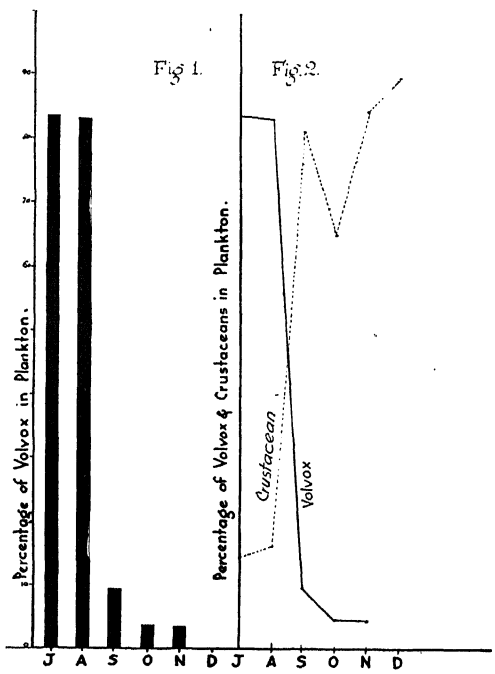


FIG. 1. *Percentage of Volvox in total plankton.* Co-ordinate denotes the percentage of *Volvox*, and the letters J to D on abscissa represent the months from July to December.

FIG. 2. *Inverse correlation between Volvox and Crustacea.* Co-ordinate represents the percentages of *Volvox* (phytoplankton) and *Crustaceans* (zooplankton) and the letters J to D on the abscissa denote the months from July to December.

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ALGINIC ACID CONTENT OF SOME OF THE COMMON SEAWEEDS OF THE GULF OF MANNAR AREA

Of the many commercially valuable products obtained from seaweeds, alginic acid (a polymer of *d*-mannuronic acid), and its salts have come to occupy a very important place. As in many other fields, the exploitation of the marine resources in India is still in its rudimentary stage and very little is known about the alginic acid content of the seaweeds of Indian waters, except for the work done on Sargassum of Cape Comorin.[1] This note records certain investigations made to estimate the alginic acid content of some of the common brown seaweeds of the Gulf of Mannar area. The investigation comprised experimental estimations of the total alginic acid content of five of the most common genera of the brown seaweeds of the area, followed by a study of

the actual yields obtained under practical conditions. The study was carried out on samples collected during the month of September and hence affords no indication of the seasonal variation in alginic acid content.

Palk Bay and Gulf of Mannar are well known for their rich algal growth in which a very large number of species are represented. The present study deals with five genera belonging to the group Phæophyceæ, *viz.* (1) *Sargassum*, (2) *Turbinaria*, (3) *Cystophyllum*, (3) *Hormophysa*, and (5) *Padina*. Since these seaweeds are available in large quantities, they appear to be the most suitable raw material for commercial exploitation. Separation of species has not been attempted in the case of *Sargassum* and *Padina* because of the difficulty in distinguishing them in the field. Further, specific differentiation of these seaweeds will be of little importance in any commercial extraction of alginic acid. However, care has been taken to concentrate on the most common species of the genera.

The estimation of the actual alginic acid content of these seaweeds were carried out by the method described by Cameron, Ross and Percival.[2] The actual yield of alginic acid from these seaweeds were determined by Stanford's method as described by Tressler,[3] the percentage value being calculated on air-dry basis (Table I).

The percentage of moisture in the seaweeds were determined by heating the sample in an air-oven at 105° C. to constant weight. The results obtained are given in Table II.

From Tables I and II it can be inferred that *Sargassum*, *Turbinaria*, *Hormophysa* and *Cystophyllum* contain a fairly good percentage of alginic acid ranging from 15·63 to 19·22% and in practice yield from 13·58 to 17·64%. The most common genera of brown seaweeds of this area are *Sargassum* and *Turbinaria* and the yield of alginic acid from these compares well with that of *Macrocystis pyrifera*, which is one of the chief sources of alginic acid in the United States of America. Hence *Sargas-*

TABLE I

Alginic acid content estimated and the actual yield on extraction

	Sargassum spp.		*Turbinaria conoides* (J. Ag.) Kutz		*Cystophyllum muricatum* (Turn) J. Ag.		*Hormophysa triquetra* (L.) Kutz		*Padina* spp.	
	A%	B%	A%	B%	A%	B%	A%	B%	A%	B%
	17·96	17·90	17·96	16·17	16·54	13·50	18·10	17·38	11·62	8·00
	20·40	17·64	18·30	15·52	15·84	13·80	18·30	16·55	10·21	8·52
	19·00	18·17	18·10	16·44	14·44	13·66	18·30	16·83	8·80	8·26
	19·36	16·86	17·96	15·38	15·48	13·36	18·10	16·71	10·56	8·65
	19·36	17·20	18·10	16·30	15·84	13·60	18·30	16·90	10·56	8·80
Mean	19·22	17·55	18·08	15·96	15·63	13·58	18·22	16·87	10·35	8·45

A—Percentage of total alginic acid estimated on air dry basis.

B—Percentage of actual yield obtained on extraction, on air dry basis.

TABLE II

Moisture content in the seaweeds, just cast ashore (air-dry basis)

Expt. No.	*Sargassum* spp. %	*Turbinaria conoides* (J.Ag.) Kutz%	*Cystophyllum muricatum* (Turn) J. Ag.%	*Hormophysa triquetra* L. Kutz %	*Padina* spp. %
I ..	81·86	84·14	84·31	84·74	83·19
II ..	81·25	83·88	84·66	85·35	83·62
III ..	83·15	83·11	86·94	83·59	83·50
IV ..	83·48	83·54	84·37	83·87	82·52
V ..	85·30	83·97	86·10	83·44	83·25
Average ..	83·01	84·13	85·28	84·20	83·22

sum and *Turbinaria* hold out good prospects in any scheme for developing the alginic acid industry in India. Though the yield of alginic acid in *Cystophyllum* is low, this seaweed may also be considered as a good raw material in view of its availability in fair quantities.

My grateful thanks are due to Dr. N. K. Panikker and Sri. K. Chidambaram for the help received during the course of this study. This work was done while the author was on the staff of the Fisheries Department of the Madras State and is published with the permission of that Department.

Central Marine Fisheries Research Station, Mandapam Camp, *August* 23, 1955. A. P. VALSAN.

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RUST ON GRAPE FRUIT

DURING March 1951 Grape fruit (*Citrus paradisci* Macfad.) was observed to be severely affected by a rust in the citrus orchard of Ali Sagar, Nizamabad District, Hyderabad State, where the climate is moist and humid. A preliminary examination revealed the presence of minute pustules on both the surfaces of the leaves. Severe infection is caused to the leaves and defoliation occurs.

Uredo citri sp. nov.

Uredia amphigenous, mostly hypophyllus, isolated or in groups, subepidermal, erumpent, pulverulent, opening by a central pore. Paraphyses none. Uredospores sessile, spherical, obovate or sub-globose, hyaline to sub-hyaline, minutely echinulate, thick-walled, germ pores indistinct, 14·5-20 × 10-18 μ (Fig. 1).

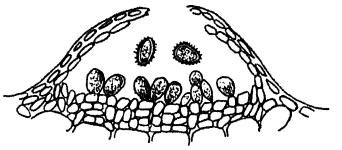


FIG. 1. Section of uredium (× 63.)

Hab. on leaves of *Citrus paradisci* Macfad. Collected at Ali Sagar during March 1951.

The assistance of Sri. V. Ravindra Nath is gratefully acknowledged.

Division of Plant Pathology, Govt. Main Exptl. Farm, Himayetsagar, Hyderabad-Dn., *February* 5, 1955. SYED VAHEEDUDDIN.

DEFICIENCY AND TOXICITY EFFECTS OF BORON ON THE PHYSIOLOGY OF BARLEY

THE importance of micro-elements in the nutrition of plants has been stressed by many workers.[1] Among such micro-elements, boron occupies an important position. Thus boron deficient barley was susceptible to *Erysiphæ graminis*.[2] Deficiency of boron was limited to the sporogenous tissue, primary disturbances being in the cell-wall.[3] While this was true of the deficiency effects, no systematic analysis of the toxicity of boron has been made in this crop. In view of the fact that no researches have been conducted on the growth and physiological characteristics of barley in relation to subnormal and supernormal concentrations of boron, a water culture experiment with (1) absolute deficiency; (2) normal dose; and (3) toxic dose of boron constituting five times the normal dose was conducted, with Hoagland's nutrient solution on barley var. C 251 in the cropping season of 1949-50. Daily aeration and change of solution twice every week was maintained to induce true response of the treatments as indicated in an earlier paper.[4]

Boron deficiency was found to result in stunted growth of plants. Leaves remained thin and underdeveloped. Leaf number on the primary shoot of boron deficient plants did not vary appreciably from the leaf number of the primary shoot of complete nutrient plant. But yellowing and drying was markedly increased. It appeared that boron deficiency reduced the life-span of the leaves which showed tendency to dry out much earlier than the control. Colour of the leaves was also poorer than that of the complete nutrient culture. Chlorotic regions were developed in mature leaves with marked uneven distribution of pigments. In contrast to the deficiency cultures, toxic boron cultures were found to be taller with the colour of leaves approaching that of the complete nutrient plants. The leaves in the toxic boron cultures, however, showed development of brownish spots, beginning from the leaf tip and extending rapidly towards the base. This was so marked that even the fourth leaf showed dried out patches. The leaves showed early desiccation and death.

Comparative physiological responses of the deficiency, normal and toxic boron cultures (Table I) showed that the normal plants contained as a rule highest concentration of chlorophyll *a*, chlorophyll *b*, carotin and xanthophyll, as compared to the deficiency or toxic cultures. It was also noted that the normal plants

TABLE I

Physiological characteristics of barley in relation to deficiency and toxicity of boron

	Apparent assimilation*	Real assimilation*	Respiration*	Chlorophyll *a*†	Chlorophyll *b*†	Carotin†	Xanthophyll†	Total green pigments†	Total yellow pigments†	Total green/total yellow
Boron deficient cultures ..	2·04	2·56	0·51	1·48	1·55	0·0019	0·0279	3·03	0·0298	101·6
Complete nutrient cultures ..	5·60	6·76	1·16	4·47	3·86	0·0048	0·0037	8·33	0·0085	980·0
Boron toxic cultures ..	1·83	2·74	0·91	3·18	0·98	0·0022	0·0021	4·16	0·0043	967·4

* mg. CO_2/100 sq. cm. leaf area/hour ; † mg./10 g. fresh weight of leaf.

had relatively higher rate of apparent and real assimilation and respiration than deficient or toxic plants. No marked differences between the latter two were evident (Table I). Concentrations of boron higher or lower than that used for the normal plants were therefore less useful in improving both general growth and physiological attributes like photosynthesis, respiration and pigment content of barley.

Plant Physiol. Lab., College of Agriculture, Banaras Hindu University, Banaras, *March* 8, 1955.

K. N. LAL.
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AN INTERSPECIFIC HYBRID IN ORYZA

Oryza sativa, Linn. (cultivated rice) has been crossed with some wild species in the genus, and Ramiah[1] has discussed the previous work. Potential cross combinations between species other than *O. sativa* are very large, but only a few have been recorded.[2,3] Observations on one such interspecific hybrid are given here.

Two species of African origin were used in this cross. One parent, *O. eichingeri*, Peter., has 48 chromosomes. The other parent, *O. glaberrima*, Steud., is 24-chromosomed and is cultivated in West Africa. The particular parent *O. glaberrima* used in the cross had long sterile lemmas and can be described as *O. glaberrima* var. *grandiglumis*. *O. eichingeri* was used as the pollen parent. Though the parents were fertile, the hybrid was completely sterile and is being kept alive by vegetative propagation. Back-crossing with either parent failed to give any seed. The pollen sterility in the hybrid was shown by the absence of well-filled pollen grains in iodine mounts.

Genetical Characters.—The following characters of the *O. eichingeri* parent behaved as dominants in the F_1: spreading habit, lax divided panicles, reduced sterile lemma and hairy shattering spikelets. This behaviour of the characters in the F_1 is parallel to that recorded in *O. sativa* (Ramiah[1]). The awn length and ligule length were greater than in either parent. The hybrid had green apiculus like *O. eichingeri* and not the pigmented apiculus of *O. glaberrima* parent. This character behaviour in F_1 is exactly the reverse of that recorded in *O. sativa* where purple apiculus character is dominant to green. In flowering duration (when sown in July), in plant height and spikelet size, the hybrid was intermediate between either parents. The random occurrence of trifid stigmas, a character present in *O. glaberrima*, was absent in the hybrid.

Cytological Observations.—The sections of the root tips of the hybrid prepared by the paraffin technique showed that the mitotic chromosomes were 36 as expected. The chromosomes showed some differences in size (Fig. 1),



FIG. 1. Mitosis in the F_1 hybrid. $2n = 36$ × c.a. 2800 magnification.

but their smallness prevented detailed study. Meiosis was studied in both the parents and in

TABLE I

Multivalent frequency in O. eichingeri *and* F_1 *hybrid*

	Maximum				Minimum				Mean			
	I	II	III	IV	I	II	III	IV	I	II	III	IV
O. eichingeri ..	2	22	2	8	0	8	0	1	0·3	15·4	0·3	4·0
F_1 hybrid ..	19	6	5	0	14	4	2	0	16·7	4·8	3·2	0

the hybrid by propionocarmine smears. In the diploid *O. glaberrima*, the meiosis was normal, 12 bivalents being regularly formed. In the tetraploid *O. eichingeri* and in the triploid hybrid, multivalents occurred in the M.I. stage and the frequencies are given in Table I.

It can be seen that quadrivalent formation occurs in *O. eichingeri*. Associations are mostly terminal. In this species, the trivalents with corresponding univalents occurred in 10 out of 40 cells observed and this could have arisen by falling apart of a chromosome from a quadrivalent.

There were no quadrivalents in the F_1 hybrid and the maximum number of trivalents was only 5. Smears of anthers in the hybrid showed that only some of the P.M.C. were dividing. In these, anaphase irregularities occurred and the movement of chromosomes was as shown in Fig. 2. The univalents, bivalents and tri-

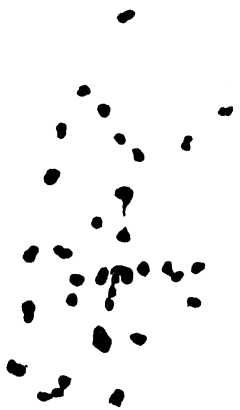


FIG. 2. Meiosis in the F_1 hybrid. Early Anaphase ; 22–I, 2–III and 4–II.

valents move to poles, irregularly. This irregular segregation is the presumed cause of gametic sterility. The tetrads did not mature to form full pollen grains.

The chromosome pairing behaviour in *O. eichingeri* and in the hybrid indicates that autosyndesis occurs in the hybrid. A maximum of 8 quadrivalents occurs in the tetraploid parent and therefore 8 autosyndetic bivalents can be formed amongst the 24 *O. eichingeri* chromosomes in the hybrid. It is therefore inferred that *O. eichingeri* must have evolved by autopolyploidy or segmental allopolyploidy. The occurrence of trivalents in the hybrid could be due only to pairing of some of *O. glaberrima* chromosomes with the autosyndetic pairs and it is seen that 5 chromosomes of this parent are homologous to 5 in the basic 12-chromosomed genom of *O. eichingeri*. In this connection it may be noted that the genus *Oryza* has evolved as a secondary allotetraploid with two different 5 chromosome basic species.[4]

On the same hypothesis, one of the basic complements (5 chromosomes) would appear to be common to the two parents (*O. glaberrima* and *O. eichingeri*).

Central Rice Res. Inst., Cuttack-4, Orissa, *August* 22, 1955.

H. K. SHAMA RAO.
R. SEETHARAMAN.

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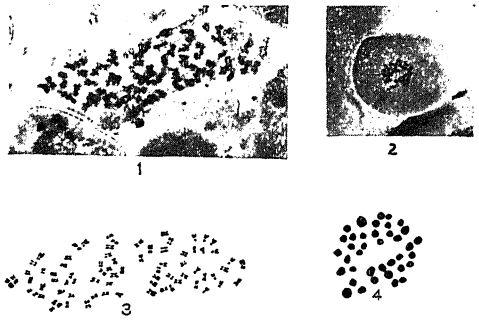
STUDIES IN THE CYTOLOGY OF *OCIMUM KILIMANDSCHARICUM* GÜRKE

CYTOLOGICAL investigations into the genus *Ocimum* is confined, so far, to a few observations made by Russian workers and reported by Darlington and Janaki Ammal.[1] These observations were made on *Ocimum gratissimum* ($2n = 64$), *O. sanctum* ($2n = 64$), *O. canum* ($2n = 64$, 128) and *O. canum* × *O. gratissimum* ($2n = 64$, 128).

In the present report the chromosome studies in the species *Ocimum kilimandscharicum* Gürke have been incorporated. Preparations of

somatic chromosomes have been made from root-tips obtained from seeds collected from our own plantation at Sukna near Darjeeling[2] and also from those kindly supplied by Dr. Dhingra, Harcourt Butler Technological Institute, Kanpur, and Controller of the Essential Oil Scheme in the United Provinces. The material was fixed in *p*-dichlorobenzene at 10-15° C. for 2½-3 hours, followed by aceto-orcein squash.[3] Meiotic stages were studied from plants grown in the experimental garden of this college. The temporary aceto-carmine squashes were made permanent following the usual procedure.

Observations revealed 76 chromosomes in the somatic cells (Figs. 1 and 3). The length of



FIGS. 1–4

Fig. 1. Photomicrograph of the somatic metaphase stage of *O. kilimandscharicum* showing 76 chromosomes. The split nature of the chromosomes is to be noted (× 900 approx.).

Fig. 2. Photomicrograph of the meiotic metaphase I of the same plant showing 38 bivalents in the polar view (× 400 approx.).

Figs. 3 & 4. Camera lucida drawings of the same plates (×700 approx.). Chromosomes in Fig. 3 are slightly spaced apart.

the chromosomes varied from 2·2-1·5 μ approximately. Metaphase plates brought out by the same technique showed diplo-chromosomes.

In meiotic metaphase plates of pollen mother cells 38 bivalents were observed in the polar view (Figs. 2 and 4). The length of the bivalents varied from 1·5-2 μ approximately.

Presidency College, Calcutta,
June 28, 1955.

J. K. CHOUDHURY.
A. K. BAL.
R. B. BOSE.

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EMBRYOLOGY OF *EUGENIA BRACTEATA* ROXB.

TIWARY,[1] PIJL[3] AND JOHNSON[4] have studied polyembryony in several species of *Eugenia*. Material of *E. bracteata* was collected by the author in 1952, from the Horticultural Gardens, Saharanpur, and the observations made are briefly stated below.

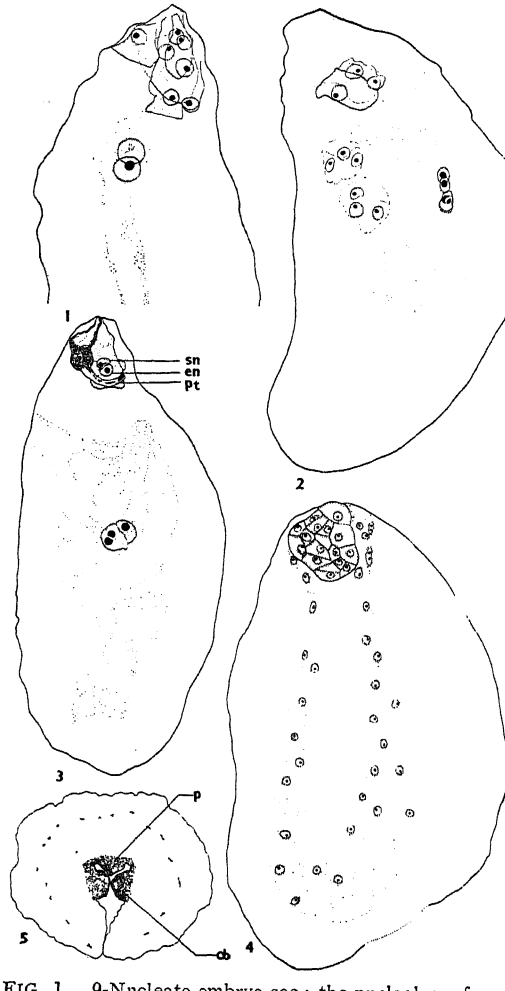


FIG. 1. 9-Nucleate embryo sac; the nucleolus of one of the polar nuclei became displaced during sectioning, × 1378. FIG. 2. 13-Nucleate embryo sac, × 1378. FIG. 3. Embryo sac showing pollen tube (*pt*) and an extra nucleolus in one of the polar nuclei. *en* – egg nucleus; *sn* – synergid nucleus, × 1378. FIG. 4. Zygotic embryo and free nuclear endosperm, × 625. FIG. 5. L.s. mature embryo showing plumule (*p*) and cotyledonary buds (*cb*), ×35.

The bilocular ovary contains fewer ovules than either *E. jambolana* or *E. jambos*. A young ovule shows two integuments, each two-layered. The youngest stage showed a megaspore mother-cell with several parietal cells above it. There is a linear tetrad of mega-

spores of which the chalazal functions. Next come the two- and four-nucleate stages. Presumably an eight-nucleate stage occurs but the author was unable to observe all the eight nuclei, probably because the antipodals are ephemeral. The commonest stage was one with a three-celled egg apparatus and two juxtaposed polar nuclei.

Frequently, the synergids are not organized as cells. Their nuclei travel down and join with the polars. In such cases, therefore, the egg and four polar nuclei are seen. Other embryo sacs showed a 3-celled egg apparatus and 3 or 4 polar nuclei, *i.e.*, a total of 6 or 7 nuclei excluding the antipodals. In one embryo sac a 9-nucleate condition was seen, 7 cells at the micropylar end and 2 functioning as polars (Fig. 1). In another 13 nuclei were observed: 4 appeared like polar nuclei and there were three groups of 3 nuclei each (some organized into cells) (Fig. 2). Still another embryo sac also showed more than 8 nuclei. It is possible that the supernumerary nuclei in the embryo sacs are either nuclei of nucellar cells, or the result of fusion of adjacent embryo sacs, or supernumerary divisions of original nuclei of the embryo sac.

A considerable amount of material of post-fertilization stages was sectioned. Pollen tubes were seen inside a few embryo sacs only. In Fig. 3 one of the polar nuclei clearly shows the existence of an extra nucleolus suggesting possible fusion with a sperm. In other cases the egg nucleus showed the presence of an extra nucleolus while the endosperm was free nuclear. Double fertilization, therefore, may be presumed to occur. In all cases the egg gives rise to the embryo. Neither in pre- nor in post-fertilization stages, was there any trace of the plasma-rich cells in the nucellus, destined to give rise to nucellar embryos. Nor was there any proliferation of the inner layer of the integument which later surrounds the embryo sac. Ovules showed only one embryo in the normal micropylar position (Fig. 4). Nucellar embryony is, therefore, absent in *E. bracteata.*

Buds are frequently produced from the cotyledons (Fig. 5), and it will not be surprising if such a seed on germination gives rise to several shoot apices and single radicle. This would not be a case of true polyembryony, however. Similar instances of the presence of buds in the axils of the cotyledons and the development of shoots from them have already been reported earlier by Tiwary[2] in *Cassia tora* and others.

I wish to thank Prof. P. Maheshwari for guidance and Prof. Y. Bharadwaja for facilities.

Dept. of Botany, S. K. Roy.
Banaras Hindu University,
Banaras-5, *July* 11, 1955.

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ANATOMY OF OPEN AND COMPACT PANICLES IN *ORYZA SATIVA*

There are two types of panicles in the cultivated types of *Oryza sativa, viz.*, the open and the compact. In the open ones the rachilla spread away from the rachis of the panicle at an angle of 45-90° and thus, the panicle appears to be open whereas, in the compact one all the rachillæ are closely pressed to the main rachis, and are almost parallel. At the time of the emergence of the panicles from the sheath all the rachillæ are appressed to the main rachis. In the open panicles, a small swelling of loose parenchymatous tissue is formed at the junction of the rachilla with the main rachis. As this tissue grows the rachillæ spread away from the rachis and when the spikelets mature and begin to ripen this tissue dries up and the branches are firmly fixed up in their position. The degree of angle these rachillæ make with the rachis depends upon the development of this tissue.

L.S. showed in both cases that some amount of parenchymatous tissue was found in the cortical region of the rachis. In the case of the open panicle, however, the epidermis of the rachilla is pushed towards the main rachis in the form of a swelling below which there are 14 to 15 layers of parenchyma cells. The vascular strands take a bend in the form of a loop in the open panicles in contrast to the straight path of the vascular strands in the compact panicles. Thus, the curved path of the vascular strands offers mechanical support to the parenchymatous tissue in pushing the rachilla away from the main axis to form the open panicle.

My thanks are due to Mr. S. Sampath of Central Rice Research Institute, Cuttack, for giving facilities to prepare the sections and to Prof. B. Samantarai and C. M. Bastia for preparing photomicrographs of the sections.

Utkal Krushi Mahabidyalaya, G. V. Chalam.
Bhubaneswar, *June* 7, 1955.

REVIEWS

Optics—Lectures on Theoretical Physics. Vol. IV. By Arnold Sommerfeld. (Translated into English by O. Laporte and P. A. Moldauer.) (New York: Academic Press), 1954. Pp. xiii + 383. Price $ 6.80.

The Adademic Press has been publishing during the last few years English translations of the Lectures on Theoretical Physics given by the late Professor Sommerfeld at Munich. This is the last but one of the six volumes to appear and one more on Thermodynamics and Statistical Mechanics is under preparation.

In a way, this volume on Optics is a continuation of Vol. III on Electrodynamics, for Sommerfeld treats the subject of optics right from the beginning on the basis of the electromagnetic theory of light. One hopes that this would become the standard practice of teaching optics in this country at least at the postgraduate level. In the first chapter on reflection and refraction of light, Sommerfeld treats the phenomena not only at one boundary, but with two parallel boundaries (as in the Fabry-Perot or Lummer-Gehrcke interferometers) as a boundary value problem for the electromagnetic waves. The next chapter deals with problems connected with the velocity of light and concludes with a short section on photons. The next chapter on dispersion is perhaps the most elegant in the book in that it discusses the whole gamut of phenomena, refractive index and absorption in the visible, infra-red and ultra-violet, Zeeman effect, magneto-optic rotation, etc., in a single coherent treatment. Chapter IV deals with the essentials of crystal optics including the general case of an optically active, birefringent crystal. The theory of diffraction is treated in two chapters, which are the most elaborate in the book, containing rigorous solutions of many problems. Particular mention must be made of Rubinowicz's formulation of Kirchoff's solution in terms of the boundary of the diffracting object, which has been given in good detail. This approach is capable of being readily applied to practical problems involving irregular diffracting objects (*Proc. Ind. Acad. Sci.*, 1945, **A-21**, 165). The book ends with a discussion of the complementarity of the wave and corpuscular theories of light. A number of suggestive problems are appended to the book, and an outline of their solutions is also given.

This book is not an exhaustive treatise on optics and few references are given to original literature. But, on the other hand, the treatment of each topic is so lucid and thorough that it would serve eminently as a text-book for the study of optics, as indeed the original lectures of Prof. Sommerfeld were intended to be. In the reviewer's opinion, this should be the regular text-book in optics for the post-graduate classes in our universities, supplemented perhaps on the experimental side by the excellent treatise of Prof. R. W. Wood.

G. N. RAMACHANDRAN.

Physical Methods of Organic Chemistry. Part III. Second Edition. Edited by A. Weissberger. (New York: Interscience), 1954. Pp. xi + 417. Price $ 8.50.

The first edition of this book appeared in two parts in 1945 and 1946, which were issued in a revised and enlarged edition in 1949. In an attempt to cover the more recent developments, the editor has wisely decided not to enlarge the first two parts, but to issue a third part incorporating new material. The present volume contains six chapters on new topics, such as electron microscopy, microspectroscopy, streaming birefringence, dielectric constant, radio-frequency spectroscopy and neutron diffraction. In addition, five chapters on viscometry, X-ray diffraction, electron diffraction, magnetism and radioactivity contain supplementary material to the earlier volumes.

It is obvious that these are not techniques which an organic chemist could readily adopt in his laboratory, for they not only require highy specialised equipment but also a person well versed in the field for their interpretation. Dr. Weissberger is obviously looking to the future in planning a volume of this type for the organic chemist, and he seems to be also fully aware of the situation, for these new chapters have been designed not so much to give full details of the methods as to give a comprehensive picture of the principles and the capabilities of each method. Selected references to recent literature are given for those who wish to enlarge their knowledge of a particular field.

Physical methods like those described in this book are being increasingly used not only in organic chemistry but even more in biochemis-

try and in the study of biological materials of high molecular weight. The three volumes will serve as an excellent source book to all those engaged in the analysis of the structure of chemical and biological materials.

G. N. RAMACHANDRAN.

Nuclear Energy and Its Uses in Peace. (A UNESCO Guidebook to the Age of the Atom), 1955. Pp. 76. Price 2 *sh.* 6 *d.*

In this booklet, Mr. Wendt offers a guided tour through the world of the nuclear fission, beginning with the days when the only source of radioactivity was radium—at $ 100 a gramme —and when uranium was used mainly to colour glassware. With a wealth of clear illustrations, he discusses nuclear fuels, reactors, nuclear power, radioactivity and the fascinating field of radioactive tracers. Then he offers a picture of what the United Nations and its agencies have already contributed toward peaceful utlization of atomic energy and what lines their future contributions will take.

One conclusion to be drawn from this booklet is that, while the world may not be in the Age of the Atom, it is certainly at its threshold. The U.S.S.R. has announced that a full-scale 50,000 kilowatt power station will be in operation very soon, In England, a 50,000 kilowatt plant is to begin production early in 1956 and construction of a 60,000 kilowatt station has started in the United States. Other power plants are being planned in France, Canada, Norway, the Netherlands, Belgium and Switzerland.

The story of radioactive tracers told by Mr. Wendt is equally impressive. Use of a radioactive substance in fertilizer quickly tells what use plants make of the fertilizer. Radioactive tracers have been able to answer questions on the resistance to wear of piston rings, shoe soles, floor waxes, paints, concrete, car tyres, to name only a few.

Organic Solvents—Physical Properties and Methods of Purification. (*Technique of Organic Chemistry,* Vol. VII.) Revised Second Edition. By John A. Riddick and Emory E. Troops, Jr. (New York: Interscience), 1955. Pp. vii + 552. Price $ 8.50.

This second edition of 'Organic Solvents' lists the important organic solvents classified systematically along with a number of their physical properties. Chapter I gives the classification of solvents under the major classes: (1) hydrocarbons, (2) compounds with one type of characteristic atom or group (hydroxy compounds, esters, ethers, etc.), and (3) compounds with more than one type of characteristic atom or group (alcohol ethers, esters of hydroxy acids, etc.). Two hundred and fifty-four solvents have been listed.

Chapter II discusses the physical properties, criteria for their selection and estimation of physical constants from related data. The physical constants of the solvents have been tabulated in Chapter III. They have also been retabulated according to their boiling points, freezing points, dielectric constants and dipole moments. Criteria of purity are reviewed in Chapter IV, and the methods of purification of the solvents are given in Chapter V.

The need for the collection and classification of such useful data on the physical constants of important organic solvents is obvious, and the volume will be of immense help not only to the organic and physical chemists, but also to research engineers who have to use such data quite often during their investigations.

G. S. LADDHA.

The Theory of Cohesion. By M. A. Jaswon. (London: Pergamon Press), 1954. Pp. viii + 245. Price 37 *sh.* 6 *d.*

The book offers an introduction to the basic ideas and the mathematical details of the wave mechanical theory of the attractive forces in molecules and in solids. This is done in three steps. The first three chapters give a short resumé of the essential ideas of wave mechanics in about 50 pages. The treatment, as the author says, is not systematic, the purpose being more to give a general outline, so as to make the book self-contained. The next three chapters deal with the applications of perturbation theory to a study of multi-electron systems both in atoms and molecules. The various applications of the atomic and molecular orbitals are discussed in full detail, with special reference to the evaluation of binding energy. The last three chapters are concerned with the applications to solids, but only metals are considered. The Brillouin zone theory is given in detail, and particular reference must be made to the rather detailed account given of the recent developments in the theory of metals.

Considering that the book is Vol. II of the series of monographs on "Metal Physics and Physical Metallurgy", the particular stress laid on metals is to be expected. However, it is felt that the elaborate account given of wave-mechanical methods could have been profitably used to discuss the problem of cohesion in ionic and covalent crystals as well. As it is, diamond

is mentioned, but only the tetravalent bonds of the free carbon atom is really discussed.

A defect noted in notation needs to be mentioned. In writing down the matrix elements of the type $\psi^* \mid H \mid \psi$, the star in the first symbol is sometimes present but is mostly absent in the later chapters of the book. In the first reading of the book, the reviewer missed the small footnote in p. 65 that the asterisk is to be understood in the appropriate places, which explain this discrepancy. Even so, it is difficult to understand why in the same equation, as in Eq. (57), p. 85, there is a star in the numerator, but not in the denominator. A similar situation is noticed in numerous places, and it is necessary to consider whether the notation for matrix elements should not be suitably modified in a future edition. The book is not also free of misprints, *e.g.*, the omission of dx in l. 13, p. 21 and of the horizontal line in Eq. 3, p. 27; the mis-spelling of one of the names at the bottom of p. 222. Some of the authors quoted in p. 222 are not to be found in the author index.

These are only minor points which in no way detract from the value of the book as a good introduction to the theory of the chemical bond.

Organic Analysis. Vol. II. Edited by John Mitchell Jr., I. M. Kolthoff, E. O. Proskauer and A. Weissberger. (New York: Interscience), 1954. Pp. viii + 372. Price $ 8.50.

The present book is the second volume to be published in a series that has been planned to present annual reviews of both chemical and instrumental methods available for analysis of organic compounds. The emphasis, as in the first volume, is on methods of functional group analysis. The chemical determinations discussed include micro-determination of carboxyl groups, determinations of esters, nitro, nitroso and nitrate groups, and applications of lithium aluminium hydride to organic analysis. The instrumental techniques discussed are coulometric methods, application of polarography to organic analysis, methods based on reaction rate, phase solubility analysis and counter current distribution.

The chapters differ in their treatment of the methods and techniques discussed and in the amount of experimental details included for carrying out specific analyses. All the chapters provide a good theoretical discussion followed in some cases by tabular surveys of the applications of the particular reaction or technique discussed. The discussions on lithium aluminium hydride and counter current distribution are timely reviews of methods which have been developed recently. The discussion on micro determination of carboxyl groups is perhaps out of place in a book of this nature since it deals only with procedures for simple titrations which are dealt with adequately in many textbooks. All the chapters are documented with references and the index included covers both Volume I and Volume II. The book will be of great value to chemists interested in organic analysis.

S. SWAMINATHAN.

(*i*) **Cumacea of the Benguela Current.** By N. S. Jones. (*Discovery Reports,* Vol. XXVII), 1955. Pp. 279-92. Price 6 *sh.* 6 *d.*

(*ii*) **The Wax Plug in the External Auditory Meatus of the Mysticeti.** By P. E. Purves. (*Discovery Reports,* Vol. XXVII.) (Cambridge University Press), 1955. Pp. 293-302. Price 10 *sh.* 6 *d.*

(*i*) The author, Dr. N. S. Jones of the Marine Biological Station, Port Erin, found five species in the material collected in March and September 1950, by R. R. S. William Scoresby off the south-west coast of Africa. Three species were new to science but the remaining two, which were best represented numerically in the collection, suggest that all the five cumacea were part of the rich population of the area off the west coast of Africa, and that they were brought up to the surface by upwelling and carried north and westwards by the Benguela current. The author makes the useful suggestion that other cumacea, especially the species of the genus *Iphinœ*, are probably widespread in southern Asiatic waters. The forms described were collected by vertical hauls especially at night. One wishes that the author had discussed more fully the factors behind the occurrence of these bottom-living forms used to low concentrations of oxygen, in the vertical hauls, since the presence of juveniles weakens the suggestion of nuptial swarms.

(*ii*) Like other features of adaptations of the Cetacea to aquatic life, the extremely small external ear passage, has attracted the attention of many since 1828. But owing to scarcity of material, accurate knowledge was not possible. The author, Dr. P. V. Purves of the British Museum, has now shown that a ceruminous wall plug extends from the base of the apparently closed earhole to the middle ear—a distance of 60 cm. in the specimens he examined. It would appear this is not really all wax, nor is it secreted

centripetally, but outwards from the region of the eardrum. The size of the eardrum region (membrane and bony framework) does not increase with the growth of the animal, but the wax is secreted in layers (annually or biennially) so that the age of the whale can be computed from the laminations. These facts together with data regarding the plug being a good transmitter of sound, are additions to our knowledge of the biology of the Cetacea.

Both sections of the *Discovery Reports* are well illustrated and deserve to be included in the library lists of marine biological institutions.

C. P. GNANAMUTHU.

Animal Cytology and Evolution. By M. J. D. White. Second Edition. Cambridge University Press, 1954. Pp. xiv + 454. Price 45 *sh*.

Animal cytologists would welcome this second edition. In a rapidly-developing field like cytology, a book is likely to become out of date in the course of a decade. Since the publication of the first edition there has been considerable addition to our knowledge regarding the chemical composition of chromosomes and the adaptive significance of cytological polymorphism in natural populations. The recent advances have necessitated a re-orientation of the matter contained in the first edition.

The evolutionary significance of chromosome numbers was not apparent to the earlier students of the subject. Modern trends give one the hope that it may be possible "to raise evolutionary theory above the rather intuitive and semi-scientific state in which it exists today". Taking a long view of the processes of evolution, White remarks "that it must involve an endless cycle of duplications, heterochromatization of euchromatin and eventually deletions, a kind of *circulation of genetic materials*" (p. 377).

Among the host of workers, Goldschmidt alone believes that new species originate only as a result of a catastrophic repatterning of the caryotype. The glimpses we get of the nuclear changes during histogenesis suggest that a repatterning of the caryotype occurs during differentiation. Evolution of cell types should have preceded evolution of multicellular species and presentation of a comprehensive picture of the role of the caryotype in evolution may be possible only when more information is available on the changes that occur in the nucleus during histogenesis.

The presentation of facts is objective and it is only natural if in some cases the author has veered to his own interpretations of the phenomena. To a serious student the new edition is a mine of information and hence would be a welcome addition to any library.

M. K. SUBRAMANIAM.

Experiments in Organic Chemistry. Third Edition. By Louis F. Fieser. (D. C. Heath & Co, Boston), 1955. Pp. 360. Price $ 5.25.

The third edition of Fieser's well-known laboratory manual is in some ways the best of the text-books on practical organic chemistry now available. It is completely modern in outlook and a worthy companion to Fieser and Fieser's *Organic Chemistry*. A slight lack of balance is common to both, but both are stimulating to read and use, and they provide an excellent background for research in organic chemistry.

The inclusion of semimacro and semimicro experiments, clearly demonstrating the possibility of giving students a wide range of experiments and training them effectively in the technique of modern organic chemistry at moderate cost, is particularly valuable for Indian laboratories which suffer from a shortage of funds. Experiments are described in great detail, aided by clear diagrams, photographs and Kodachrome reproductions. Typical of the sound practical advice in which the book abounds is the following: "Considerable time can be saved by cleaning each piece of equipment immediately after it has been used, for you will know then what type of contaminant is present and you will be able to remove it more easily than after it has dried and hardened".

Part I, consisting of 42 chapters, deals with experimental technique and the preparation of a representative series of organic compounds. Examples are given of enzymatic resolution, elution and paper chromatography, use of ultraviolet and infrared spectra, and cost calculation. In Part II, Mary Fieser has contributed a chapter on use of the literature, and the Fiesers together have listed in Chapter 50 the more important reagents which are useful for general purposes and for special applications in organic chemistry. Other chapters of Part II cover miscellaneous topics, such as reaction temperatures, evaporation, solvents, accessories for reactions, and glass blowing.

K. V.

Books Received

Blood Coagulation and Thrombosis—British Medical Bulletin, Vol. 11, No. 1 (1955). Pp. 1-82. Price 15 *sh.*

Hormones in Production—British Medical Bulletin, Vol. 11, No. 2. (The Medical Department, The British Council, 65, Davis Street, London, W. 1), 1955. Pp. 83-168. Price 15 *sh.*

Determination of Organic Structures by Physical Methods. Edited by E. A. Braude and F. C. Nachod. (Academic Press, Inc.), 1955. Pp. xiii + 810. Price $ 15.00.

Annual Review of Biochemistry, Vol. 24. Edited by J. Murray Luck, Herbert S. Loring and Gordon Mackinney. (Annual Reviews, Inc., California, U.S.A.), 1955. Pp. xvi + 805. Price $ 7.00.

The Ether and Its Vortices. By C. F. Krafft. (Published by the author, Route 2, Box 687, Anandale, Virginia), 1955. Pp. vii + 66.

Principles and Practice of Antibiotic Therapy. By Henry Welch in collaboration with sixteen clinicians. (Medical Encyclopædia, Inc., Interscience), 1954. Pp. xix + 699. Price $ 12.00.

Erythromycin. (Antibiotics Monograph No. 1.) By Wallace E. Herrell. (Medical Encyclopædia, Inc., Interscience Pub.), 1955. Pp. viii + 56. Price $ 3.00.

Antibiotics Annual, 1954-55. Edited by Henry Welch and Felix Marti-Ibanez. (1955). Pp. ix + 1154. Price $ 10.00.

Luminescence of Biological Systems. Edited by H. Johnson. (AAAS, Washington 5, D.C.), 1955. Pp. xi + 452. Price $ 7.00.

Advances in Experimental Caries Research. Edited by Reidar F. Sognnaes. (AAAS, Washington 5, D.C.), 1955. Pp. ix + 236. Price $ 6.75.

Antimetabolites and Cancer. (AAAS, Washington 5, D.C.), 1955. Pp. vi + 312. Price $ 5.75.

SYMPOSIUM ON ARTIFICIAL RAIN*

A SYMPOSIUM on artificial rain was held under the joint auspices of the Council of Scientific and Industrial Research and the Indian Meteorological Department in February 1953 in New Delhi, and the proceedings have since been published.

Twenty papers were presented and discussed at the symposium. The main conclusions derivable from the discussions may be summarised as follows:

(1) The results of the experiments carried out so far on the subject have been generally inconclusive; neither complete failure of the methods employed nor the certainty of getting any substantial increase of rainfall by those methods have been demonstrated; (2) the most favourable meteorological conditions for the artificial inducement of precipitation are to be sought in regions and during seasons where natural precipitation is most likely; (3) the methods so far employed, *viz.*, seeding clouds of temperature below the freezing temperature with dry ice or silver iodide, and spraying clouds of temperature above the freezing temperature with water have not been effective in augmenting precipitation in an area of very low rainfall or during dry periods in regions of normally moderate rainfall.

These tentative conclusions indicate the need for further studies and experiments on artificial modification of clouds and precipitation. There is, in fact, urgent necessity for properly designed and rigorously checked experiments being undertaken in regions where there is a possibility of success, and for proper methods being developed to evaluate the amount of precipitation resulting from such experiments. It is also essential that in all such experiments, the collaboration of the meteorological service is made available for ensuring the required reliability in the interpretation and assessment of the result.

The volume also contains as Appendix I abstracts of papers not published in full in the volume; Appendix II contains the recommendations made by the Atmospheric Research Committee to the CSIR in the light of the symposium. The Council has accepted the recommendations in principle, and has been considering the implementation of the proposal of forming a Rain Research Unit and a Cloud Physics Research Unit, to facilitate further advances in this important subject.

* *Symposium on Artificial Rain* (Published by the CSIR, New Delhi), 1955, pp. v + 148, Price not given.

SCIENCE NOTES AND NEWS

Early Occurrence of Red Rot in Bihar

S. L. Sharma and H. C. Jha, Central Sugarcane Research Station, Pusa, Bihar, observe that red rot lesions in sugarrane on mid-ribs of leaves just emerging and acervuli on the spindle were noticed as early as 14th April this year. In the beginning, the affected portion of leaf midrib become straw-coloured at several places. In the discoloured area there were dark grey or blackish blotches surrounded by a deep red margin. Spindles on pulling out, showed reddish pink spore masses which on culturing on oat meal agar gave typical red rot colony of 'D' strain. The shoots ultimately dried up and died. In the fields too, the disease has been noted early in May in Hasanpur (Darbhanga) and Riga (Muzaffarpur), in June in Lauriya, Narkatiaganj, and Bagaha (Champaran) in North Bihar.

Award of Research Degree

The Andhra University has awarded the D.Sc. Degree in Geology to Sri. M. Poornachandra Rao for his thesis entitled, "Some Aspects of Marine Geology in Certain Parts of Bay of Bengal".

The University of Bombay has awarded the Ph.D. Degree in Chemistry to Sri. P. R. J. Gangadharam for his thesis entitled "Studies on the Chemotherapy of Tuberculosis".

The Lucknow University has awarded the Ph.D. Degree in Geology to Shri C. G. K. Ramanujam for his thesis entitled "Fossil Woods from the Tertiary Rocks of South India".

The University of Poona has awarded the Ph.D. Degree in Agricultural Plant Pathology to Shri Veerendra Vijayshanker Bhatt for his thesis entitled, "Further Studies on Phytopathogenic Bacteria of India".

Dr. K. R. Surange

The International Organization of Palæobotany is publishing a Report on World Palæobotany with a board of regional editors to collect and forward reports on all books and papers published in their respective regions. Dr. Surange, Assistant Director and Officer-in-Charge, Birbal Sahni Institute of Palæobotany, Lucknow, has been appointed as the Regional Editor for Asia. Dr. Surange has also been elected as a member of the International Committee for Palæobotanical Nomenclature.

Zoological Society of India—Award of Bhalerao Memorial Medal

The Zoological Society of India will award the above medal in January 1956, in respect of contributions in helminthology, both pure and applied, by any research worker in India (irrespective of the year of publication).

Workers in helminthology are requested to send reprints of their contributions and three copies of a list of these reprints. The adjudication for the award will be made only on the basis of reprints submitted.

Reprints should be addressed to Shri M. A. Moghe, Department of Zoology, Poona University, Poona-7.

Memorial to Prof. H. K. Mookerjee

The Zoological Society has formed a Professor H. K. Mookerjee Memorial Committee with Professor S. N. Bose as President, to perpetuate the memory of Professor Himadri Kumar Mookerjee, former Head of the Department of Zoology, Calcutta University, and President of the Society. The Committee appeals to all friends, students and admirers of the late Professor Mookerjee to contribute liberally towards the fund for raising a suitable memorial. All contributions may kindly be sent to the Hony. Treasurer, The Zoological Society, 35, Ballygunge Circular Road, Calcutta-19.

International Symposium on Macromolecular Chemistry

The above symposium will be held under the auspices of the International Union of Pure and Applied Chemistry and the Weizmann Institute of Science, in Rehovot, Israel, on April 3-9, 1956.

The object of the symposium is to discuss the behaviour of polymers, biocolloids and polyelectrolytes in solution, but it is hoped that the symposium will also provide an opportunity for a general exchange of ideas, between polymer chemists and biophysicists on the biological implications of the physical chemistry of biocolloids and polyelectrolytes. Further particulars can be had from Prof. A. Katchalsky, Head of the Department of Polymers, Weizmann Institute of Science, Rehovot, Israel.

INSDOC Report, 1954-55

This third report, presenting the activities of the Indian National Scientific Documentation Centre, New Delhi-12, records continued efforts in organising and executing documentation service. The demands made on the Centre have been heavy, and have far exceeded the earlier anticipation. In the category of responsive documentation, INSDOC received 4,800 orders for services, comprising copies of 4,336 documents, translations of 411 scientific articles, and requests to conduct 53 literature searches. In 1953-54 the total orders received were 3,531. The increase recorded this year comes to 36%.

INSDOC entered the field of active documentation with the publication on June 1, 1954, of a semi-monthly, classified bibliographical journal entitled *INSDOC List of Current Scientific Literature*. The periodical furnishes advance information about published papers, and has been well received, both in India and abroad.

Chemical Extraction of Cane Sugar

The first successful plant for extracting sugar by continuous diffusion process has started operation at Fellsmore Sugar Producers Associations' Factory at Fellsmore, Fla. The installation is a pilot plant but its designers, National Cylinder Gas Co., have blueprints for plants capable of outputs of 150-1,500 tons a day.

On the figures published, the present crude method of extracting the juice by crushing the cane between rollers will not be competitive with diffusion, in which sliced cane is circulated with hot water and recycled juice in a tower. The effect is to render the cell walls permeable and dissolve out the sucrose by osmotic transfer. A juice extraction of 97% is guaranteed and may be as high as 99%, with a purity two or three points higher than for milling because more impurities are left in the exhausted cane. The chemical plant requires half the weight of steel of a mill of the same capacity, costs half as much, needs less than half the power and is operated by two men.

—*Chemical Engg.*, May 1955.

Aerial Blobs

In a recent paper in *Science*, F. Zwicky calls attention to some striking features of the stellar scintillations and excursions that are due to what may be termed aerial 'blobs'. Although many atmospheric disturbances refract, diffract, scatter or absorb light from distant celestial and terrestrial sources in an irregular manner, aerial blobs which are volumes of air of locally altered density, temperature and water content possess remarkable optical properties. Blobs in combination with the mirrors or lenses of a telescope often bodily displace the images of stars or focus them in points in front or behind the regular focal surface.

Linear dimensions of aerial blobs have been observed ranging from millimetres to many metres. Blobs may be globular, lenticular, or cylindrical in shape, thus producing sharp point-like or line-like extra-focal images of stars. Often hundreds of blobs are quite regularly spaced and drift with the winds at various altitudes up to 50 km. or perhaps higher.

A most amazing feature of many aerial blobs is their durability and stability; some of them preserve their shapes for hours. The reasons for the durability of aerial blobs are not yet well known. It is suggested that their stability is related to the thermal, caloric and electric phenomena that govern and regulate the water content of the blobs.

New Alkaloids from *Rauwolfia*

Sandoz, Inc. of Basle, Switzerland, have reported the isolation of two additional alkaloids from *Rauwolfia canescens*. These are pseudoyohimbine and canescine, the latter having pharmacological properties similar to those of reserpine. The methoxy group in position 11 of the reserpine molecule is absent in canescine but this does not seem to be necessary for the action of these compounds.

Raunormine, an alkaloid isolated from a species of *Rauwolfia* not exploited commercially previously, has been isolated by the research group in S. B. Penick & Co. The alkaloid is believed to be identical with canescine (*Chem. Eng. News*, 1955, 33, 1076).

Fuels and Lubricants Laboratory

A new Fuels and Lubricants Testing Laboratory was recently inaugurated by Professor M. S. Thacker in the Internal Combustion Engineering Department of the Indian Institute of Science, Bangalore. Equipment for the new laboratory has been largely contributed by a number of German industrial firms. The setting up of the laboratory is the first step towards a more scientific approach to the problem of utilization of indigenous fuels in India.

ERRATA

Article on 'Structure of DL-Aspartic Acid' (1955, 24, 294), column 1; para 2; line 3: *read* internal *for* integral. In Table I, under *z* (row 6): *read* 0·049 *for* 0·094.

1338-55. Printed at The Bangalore Press, Bangalore City, by C. Vasudeva Rao, Superintendent, and Published by A. V. Telang, M.A., for the Current Science Association, Bangalore.
Editor: Prof. G. N. Ramachandran, A. C. College of Technology, Madras 25

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THE THERMAL ENERGY OF CRYSTALS*

By Sir C. V. Raman

THE determination of the nature of the atomic movements which constitute the thermal agitation in a crystal is a fundamental problem in the physics of the solid state. Its importance will be evident when it is remarked that even the most familiar aspects of the thermal behaviour of solids depend for their explanation on the precise nature of these movements. The subject also stands in the closest relationship with the spectroscopic behaviour of crystals and with X-ray crystallography, to say nothing of various other branches of physics.

Since the atomic movements under consideration are of thermal origin and are presumably in the nature of vibrations about the atomic positions of equilibrium, the subject has to be viewed in the light of the fundamental principles of thermodynamics and the quantum theory. However, as in the parallel problem of the vibration spectra of molecules, we have to seek the aid of classical mechanics for ascertaining the modes and frequencies of vibration with which we are concerned.

2. Thermodynamic Considerations

Every crystal is a three-dimensional grouping in space of atoms held together by their mutual interactions; equivalent atoms

* "The Nature of the Thermal Agitation in Crystals," by Sir C. V. Raman, Memoir No. 77 from the Raman Research Institute, Bangalore, and *Proc. Ind. Acad. Sci.*, 1955, **42**, 163-74.

in the crystal are located at the points of a Bravais lattice, and if the crystal consists of p interpenetrating Bravais lattices, there would be p atoms in each unit cell of the crystal structure. Since the frequencies of vibration of the atoms are determined by their masses and by the interatomic forces which are of limited range, they would necessarily be the same for the group of atoms contained in every cell of the structure. Hence every crystal may be considered as an assembly of a great number of oscillators physically similar to each other and having a set of vibration frequencies in common, and which since the oscillators can exchange energy with each other, constitute a system in thermodynamic equilibrium. Each oscillator can for any particular frequency of vibration assume any of the energy states permitted by the quantum theory, the probability of its being present in any one state being given by Boltzmann's well-known formula. The energy of the entire assembly of oscillators can therefore be evaluated by multiplying the number of oscillators of any particular frequency by the average energy of an oscillator of that frequency which is calculable from the relative probabilities of its different energy states, and then summing up the results for all the frequencies. The total number of oscillators included in such a reckoning would be three times the number of atoms comprising the crystal. This follows from the theorem in classical mechanics which states that the number of normal modes of vibration of a connected system of particles is the same as the number of degrees of freedom of movement of the entire system.

3. Dynamical Theory

The dynamics of atomic vibration in a crystal may be dealt with from two different standpoints which may be designated as the "molecular" and "molar" points of view respectively. In the "molecular" approach to the problem, we fix our attention on a particular unit cell of the crystal structure and proceed to write down and solve the $3p$ equations of motion of the p atoms contained in it, with a view to discover and enumerate their normal modes of vibration. In doing this we have necessarily to take account of the forces arising from the movements of the atoms in the surrounding cells which interact with those in the cell under consideration. It is obvious that no mode of vibration of the atoms in the unit cell can persist unchanged unless the atoms in the surrounding cells also vibrate in a similar mode with the same frequency. This would be the case if equivalent atoms in these outer cells also vibrate with the same amplitudes but as regards their phases of vibration there are several distinct possibilities. A formal investigation shows that there are $2 \times 2 \times 2$ or eight possibilities in all which can be described as follows: The phases of equivalent atoms are either the same or else opposite in consecutive cells along one, or two, or all the three axes of the Bravais lattice. The identity of the amplitude of vibration of equivalent atoms reduces the number of independent co-ordinates to $3p$ only. Thus, the equations can be solved and result in $3p$ solutions, but as there are eight different situations in respect of the phases, we have $8 \times 3p = 24p$ solutions in all. This is the same as the number of degrees of dynamic freedom of the $8p$ atoms contained in a super-cell having twice the linear dimensions of the unit cell of the crystal structure. Accordingly, we recognize $(24p - 3)$ normal modes of vibration properly so-called, the three omitted degrees of freedom representing the translatory movements of the super-cell.

In the "molar" approach to the problem, we consider the entire crystal as a single physical entity and investigate the propagation of waves through its structure. The wave equations are found to be formally satisfied if it be assumed that the equivalent atoms located at the points of a Bravais lattice have the same amplitude of vibration,

this however being different for the different lattices of atoms, while the frequency, wave-length and the direction of the wave-vector are the same for all the interpenetrating lattices. Proceeding to solve the set of $3p$ equations obtained on this basis, an algebraic equation of degree $3p$ for the frequency results, and the solution of this gives us $3p$ different frequencies for a wave of given wave-length travelling in any assigned direction. By considering the functional dependence of these $3p$ frequencies on the wave-length and direction of propagation, it is found that the group-velocity of the waves vanishes for $(24p-3)$ frequencies associated with eight different wave-vectors in the crystal. The $(24p-3)$ frequencies thus obtained and the corresponding modes of vibration are found to be the same as the frequencies and normal modes deduced by the "molecular" approach to the problem, namely, those in which equivalent atoms in consecutive cells vibrate with the same amplitude and with phases that are either the same or else opposite along one, two or all three of the Bravais axes of the crystal. They may therefore be identified as the characteristic or normal modes and frequencies of vibration of the crystal structure. The three omitted frequencies represent the limiting case of the three sets of waves of the lowest frequencies and the longest wave-lengths for which the group velocity does not vanish but comes out as equal to the phase-velocity of the waves. These cases are identifiable with the three types of waves whose propagation in any direction in the crystal is shown to be possible by the classical theory of elasticity. The vanishing of the group velocity for all the $(24p-3)$ frequencies characteristic of the lattice structure is significant. It indicates that no wave-propagation in any real or physical sense is possible in a crystal except in the lowest range of frequencies where alone the ideas and results of the classical theory of elasticity possess any validity.

4. The Spectrum of the Thermal Agitation

The results of the dynamical theory enable us to complete the thermodynamic picture already indicated above in outline. The p interpenetrating Bravais lattices of atoms constituting the crystal represent an assembly of atomic oscillators which have a set of $(24p-3)$ vibration frequencies in common. Each of these oscillators can assume one or another of the various energy states for these frequencies permitted by the quantum theory, the relative probabilities of the same being given by the Boltzmann formula. It would not be possible to specify or predict which of the great number of oscillators in the crystal would be in a particular excited state for any of its possible frequencies of vibration at any given instant. In other words, the thermal energy would be distributed through the volume of the crystal in a manner which fluctuates from place to place and from instant to instant in an unpredictable fashion. The fluctuating character of the energy distribution would be the more striking, the higher the frequency under consideration, since the energy jumps indicated by the quantum theory are proportional to the frequency.

Thus, it emerges that $(24p-3)$ out of every $24p$ degrees of freedom of atomic movement in the crystal manifest themselves in the thermal agitation as modes of internal vibration with a precisely defined set of monochromatic frequencies and in modes specifically related to the crystal structure, though they are localised in the crystal in a chaotic and unpredictable fashion. The residual 3 degrees out of every $24p$ degrees of freedom represent, as we have seen, the translatory movements of the super-cells of the crystal lattice. Such movements would disturb the regularity of the crystal structure, in other words, would give rise to stresses and strains of the same general nature as those contemplated in the classical theory of elasticity. Hence, the 3 residual

degrees of freedom would also manifest themselves in the thermal agitation as oscillations localised in the crystal in a chaotic and unpredictable fashion, but since the moving masses are now larger, the frequencies would necessarily be lower, being determined by the dimensions of the volume elements which can be regarded as the individual oscillators: the larger these volume elements are, the fewer of them would be needed to fill the crystal and the lower also would be the frequency. Thus, the spectrum of the thermal agitation resulting from movements of the kind under consideration would stretch over a range of frequencies down to low values, but the upper parts of the range would be much more densely populated than the lower.

5. Remarks on Some Earlier Theories

The attentive reader would have noticed that the picture of the thermal agitation in a crystal and its spectroscopic characters which has emerged bears no resemblance whatever to that figuring in the well-known theory of the specific heat of crystals put forward by Debye and in the lattice theory of Max Born and his collaborators. These authors identify the energy of the thermal agitation in a crystal with the energy of an immense number of waves traversing the crystal in all possible directions and of which the frequencies are all different. But nevertheless in evaluating the total energy, these authors make use of the expression for the average energy of an oscillator derived by Einstein for an assembly consisting of an immense number of oscillators having an identical frequency of vibration. In the circumstances, it would not be superfluous to set out briefly the considerations which show that the theories of Debye and Born are fundamentally misconceived and that the conclusions to which they lead are completely unreal.

I. The theory of the specific heat of crystals has necessarily to be based on the theorem in classical mechanics which states that the normal modes of vibration of a connected system of particles form an enumerable set equal in number to the number of degrees of dynamical freedom of the system and that in each such normal mode, all the particles vibrate with the same or opposite phases. Waves are not normal modes, since the phase alters progressively in the direction of the wave-vector, and hence it is an obviously fallacious procedure to seek to found a theory of specific heat on the basis of wave-motions.

II. A dynamical investigation shows that waves of the kind contemplated by the classical theory of elasticity in which the phase-velocity is equal to the group velocity are only possible in the limiting case of very low frequencies and of very great wave-lengths. It also shows that the atoms in a crystal form an assembly of oscillators which have a set of $(24p-3)$ vibration frequencies common to all, and hence form a system to which the principle of Boltzmann can be legitimately applied to determine the average energy of an oscillator of each frequency and thereby to evaluate the total energy of the system.

III. The fundamental principles of thermodynamics and the quantum theory indicate that the thermal agitation in a medium consisting of material particles capable of vibrating about their positions of equilibrium is of a chaotic and unpredictable character exhibiting fluctuations in the energy of the vibration from place to place and from instant to instant whose magnitude is determined by the frequency of vibration and hence would be different for each different frequency. It would be patently absurd to identify such a disturbance in the crystal with waves of constant amplitude spread over its volume.

IV. The identification of the thermal energy of a crystal with the energy of waves traversing it in all directions and having

frequencies all different from each other leads to a totally false picture of the spectroscopic behaviour of crystals, as is shown by several independent methods of experimental investigation. For instance, all crystals usually exhibit at room temperature and always when cooled down to low temperatures the sharply defined shifts of frequency in the spectrum of monochromatic light scattered by them, corresponding to each of the $(3p-3)$ frequencies of the structure active in light-scattering. Significantly also, overtones and combinations of these $(3p-3)$ frequencies and of the remaining $21p$ frequencies manifest themselves with observable intensity as sharply defined frequency shifts with many crystals.

V. That the identification of the thermal agitation in a crystal with waves traversing the solid is a misconceived idea is also apparent from the complete dissimilarity between heat energy and sound energy in their observable behaviour. The latter travels through a crystal with a velocity of some thousands of metres per second, while heat energy merely diffuses through it.

NOBEL PRIZE FOR PHYSICS, 1955

THE Nobel Prize for Physics has been awarded this year jointly to Prof. W. E. Lamb and Prof. P. Kusch, for studies on the hyperfine structure of hydrogen and other atoms in the radio-frequency region and the precision determination of the magnetic moment of the electron, carried out at the Columbia University, New York.

These studies were initiated by Lamb soon after the close of the war in 1945, utilising the various new techniques developed during the war in the production and measurement of microwaves. It is known that the level $n=2$ of the hydrogen atom has three quantum states $^2S_{\frac{1}{2}}$, $^2P_{\frac{1}{2}}$ and $^2P_{3/2}$. The Dirac theory of the electron requires that the first two of these must correspond to the same energy, while the third, $^2P_{3/2}$, will be different. However, a careful study of the fine-structure of the H_α line ($n=3$ to $n=2$) indicated that the former two may not be identical. Theoretically, such a difference would be expected owing to the interaction of the electron with the electromagnetic field, the so-called radiative correction. Another consequence of this would be that the magnetic moment of the electron due to its spin will differ from its classical value by a small amount of the order of $1{\cdot}1\times10^{-3}$.

The H_α fine structure measurements could not give an accurate value of the $^2S_{\frac{1}{2}}-{}^2P_{\frac{1}{2}}$ separation. In 1947, Lamb and Retherford measured this separation by obtaining metastable atoms of hydrogen in the $^2S_{\frac{1}{2}}$ state and directly inducing transitions in them to the $^2P_{\frac{1}{2}}$ state by means of microwave radiations of the appropriate frequency. They obtained a value $1{,}062\pm5$ MC/S with both hydrogen and deuterium.

Kusch and collaborators continued these experiments with various elements, and they were able to show definitely the existence of an anomalous electron spin magnetic moment. In 1952, they made a carefully planned series of experiments to measure this with great precision and obtained a value $g_s/g_p=658{\cdot}2288\pm0{\cdot}0006$ for the ratio of the g values of the free electron spin and of the proton. Earlier measurements of Purcell (Nobel Prize winner for 1952) and collaborators had yielded a value $657{\cdot}475\pm0{\cdot}008$ for the ratio $2g_l/g_p$ where g_l is the electron orbital g value. Combining the two, the magnetic moment of the electron was calculated to be 1·001146 times the value given by the Dirac theory, in almost perfect agreement with the value 1·0011454 calculated from theory to the fourth order approximation.

The precise studies of Lamb, Kusch and their collaborators have led to valuable data which have helped in giving confidence to the quantum electrodynamists that the rather revolutionary ideas of re-normalisation which they have introduced in their theories are in the right lines.

Prof. Lamb, who is 42, is Professor of Physics of the Stanford University, California, since 1951. Prof. Kusch (44) was associated with research at Columbia University during the war and afterwards joined the Bell Telephone Laboratories. He is now a Professor at Columbia University, New York.

INFLUENCE OF TOTAL BODY X-RAY IRRADIATION ON METHIONINE AND CHOLINE LEVELS IN RAT LIVERS

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ONE of the earliest events in the sequence of reactions, that result after radiation exposures, is the formation of free radicals like H, OH, HO_2, etc.[1,2] These radicals being very reactive and consequently of a very unstable nature combine with some of the essential metabolites of the system and thus bring about radiation damages like lowering of RBC and WBC counts, inducing hæmorrhages, etc., by blocking one system or another. Among the many compounds that are normally present in the metabolic pool, SH compounds appear to be more sensitive to the action of the free-radicals. Various SH containing compounds such as cysteine, BAL, thiourea, glutathione, etc., have therefore been tried therapeutically to counteract the radiation damages without much success.[3-5] Apparently the changes in the metabolic pool are of such a nature that they cannot be reversed by any of the SH containing compounds tested so far. Experiments with micro-organisms[3,6] tissues,[7] animals,[8,9] etc., have shown that these compounds do show some amount of protection if administered prior to radiation. This probably implies that the added compounds successfully compete with substances in the metabolic pool in their avidity for combination with free radicals.

Although quite a large amount of information is available about the lability of SH containing compounds to radiation exposures,[10-15] very little appears to be known about the fate of other sulphur containing metabolites in the body. Methionine which contains a $S\text{-}CH_3$ group calls for special attention for two reasons: (*i*) it is an essential amino acid, and (*ii*) it takes part in the biological transfer of methyl groups. Experiments have therefore been carried out to study the effect of total body irradiation on the levels of methionine in rat livers. Since choline is one of the first products formed as a result of transfer of methyl group, levels of choline have also been studied in irradiated animals and are reported in this communication.

EXPERIMENTAL

Wister rats, 2½-3 months old, weighing between 200-250 g., have been used in the present investigation. The animals were irradiated with X-rays using 230 KV Westinghouse machine with 1 mm. Al and 0·5 mm. cu. filters. Whole body irradiation of 600 *r* (L.D. 50 for rats in 30 days) was given at a rate of 50 *r* per minute by exposing the dorsal and ventral sides to 300 *r* each. Methionine levels were studied at 24 hours after irradiation whereas choline levels were determined at 24 and 48 hours after irradiation. Independent sets of experiments were carried out for studying the levels of methionine and choline. All the animals, controls as well as experimental, were fasted for 24 hours before sacrifice. Animals were killed by dislocation of the cervical vertebræ, and the livers were immediately dissected out and processed for the assay of methionine or choline as the case may be.

For the estimations of methionine, the livers were homogenised in 0·013 N acetic acid and the homogenate boiled for a couple of minutes. This procedure extracts the free amino acids and at the same time coagulates the tissue proteins, which are subsequently removed by filtration. The filtrates are further deproteinised by adding 1 ml. of 10% tungstic acid per 5 g. of tissue taken according to the method of Solomon *et al.*[16] for the estimation of free amino acids. The deproteinised filtrate is adjusted to pH 6·8 and aliquots taken for the microbiological assay of methionine using the organism *Leuconostoc mesenteroides* P-60.[17]

For the assay of choline the micromethod of Erickson *et al.*[18] was followed. The liver tissue is extracted with $CH_3OH : CHCl_3$ (1 : 1) and the extract is concentrated on a water-bath. The residue is hydrolysed with 5 ml. of saturated $Ba(OH)_2$ and then neutralised with 10% HCl and filtered. Suitable aliquots of the filtrate are treated with iodine-iodide reagent in cold to precipitate choline as its enneaiodide. The precipitate is oxidised by bromine in acetate solution and the iodate thus formed is directly titrated against standard sodium thiosulphate.

The results are given in Table I.

It will be seen from the table that methionine levels drop to 25% of the levels in control animals at 24 hours after irradiation. Choline levels on the other hand drop to 66 and 57% of the control values at 24 and 48 hours after irradiation respectively. This clearly shows that methionine containing an active

S-methyl group is very radio-labile and our unpublished results (not included here) further suggest that the cleavage is probably taking place at S-C linkages.

TABLE I

Effect of total body irradiation (600 r) *on free-methionine and choline levels in rat livers at* 24 *and* 48 *hours after irradiation*

Group	Amount of methionine μg/g. of liver	Amount of choline mg./g. of liver
Control ..	86·16±5·83 (10)	9·31±0·064 (4)
24 hr. after irradiation	18·75±0·79 (11)	6·22±0·26 (4)
48 hr. after irradiation	..	5·44±0·19 (4)

Figures in paranthesis indicate the number of animals used. The standard errors have been calculated using the formula $[\Sigma d^2/n(n-1)]^{\frac{1}{2}}$.

Grateful thanks are due to Dr. V. R. Khanolkar and Dr. A. R. Gopal Ayengar for helpful suggestions and criticisms, and to Drs. Mody and Vohra of Tata Memorial Hospital and Dr. M. S. Waravdekar of Bombay Hospital for providing the facilities of irradiating the animals.

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THE ANTI-PROTON

THE Atomic Energy Commission and the University of California have jointly announced the discovery of a new atomic particle, the anti-proton, which may open the way to a fuller understanding of basic nuclear processes.

The anti-proton, or negative proton, is not a part of the atomic nucleus, which consists of only protons and neutrons, but is created after some event such as a high energy collision of nuclear particles. The main reason why the anti-proton was not discovered earlier is that it occurs only at high energy, and until the construction of the great "bevatron" on the University of California's campus at Berkeley it was impossible to create nuclear bombardments of sufficient energy.

The "bevatron", which was built and operated by the A.E.C. enabled protons to be accelerated to 60,000 million electron volts, at which point they were directed at a target of copper inside the "bevatron" chamber. The collision of one of the protons with a neutron of copper produced not only the original proton and neutron but also a new set of heavy particles—another proton, and an anti-proton. In the collision, a part of the bombarding proton energy is converted into mass, according to Einstein's theory.

In a vacuum the anti-proton is stable and will not disappear spontaneously, but in contact with a proton both particles immediately decay into mesons and disappear; this has led some reports to describe the anti-proton as the "annihilator of matter". To identify the anti-proton a "maze" was devised through which only anti-protons could pass.

The term "reverse matter", which has also been used in some reports, is a reference to the further speculation that elsewhere in the universe there might exist matter in which all the protons were negative and all the electrons positive—a sort of "looking glass" world. The discovery confirms earlier reports by Dr. M. Schein of Chicago University and Professor Bruno Rossi of the Massachusetts Institute of Technology, who, however, had less satisfactory evidence.

A NEW EQUATION FOR THE OXYGEN DISSOCIATION CURVE OF BLOOD

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OXYGEN dissociation curves of blood have attracted the attention of many physiologists and physical chemists for well over forty years. It is well known that in case of pure dialysed hæmoglobin, the curve assumes the shape of a simple Langmuir adsorption isotherm, while in the case of blood, a number of S-shaped curves are obtained under various conditions. The percentage oxygen absorption by blood decreases with (*a*) a decrease in the pH (*i.e.*, an increase in eH[1]), (*b*) an increase in the mineral salt concentration, or (*c*) an increase in the carbon dioxide tension.[2] Many attempts have so far been made to explain this phenomenon and also to derive a suitable equation for these curves, epecially by Hill,[3] Adair[4] and by L. Pauling[5] besides several others. Hill's equation was discarded as empirical and unsatisfactory.[6] Many of the other equations are based on assumptions and hypotheses of very advanced nature and are rather complicated, involving a number of constants. Further, these equations govern only one or two aspects of the problem and are not very satisfactory at the extreme oxygen tensions. Thus, a simple and comprehensive equation, covering all the influencing factors, does not seem to have been worked out yet.

A reinvestigation of the problem, based on elementary physico-chemical principles, has therefore been taken up by the present author. This investigation is based on two postulates, evidence in support of which can be cited from the more recent work on hæmoglobin.

(*i*) It is the hæmoglobinate *ion* that takes up oxygen and not the unionised hæmoglobin *molecule* as was assumed by the previous investigators. This is supported by the fact that about 65% of the hæmoglobin in blood exists as the potassium salt and only 35% as free hæmoglobin. Instances can be cited where such organic ions (though less complex ones) take up oxygen in alkaline media. Further, this postulate explains the increased oxygen absorption with increased alkalinity (pH) of blood, as also the influence of mineral salts.

(*ii*) Osmotic pressure determinations of hæmoglobin by Gutfreund[7] show evidence in favour of its dissociation, though only to a slight extent. It is therefore postulated that in blood, Hb_4 exists in a dissociation equilibrium with Hb and that it is the Hb that actually combines with oxygen giving HbO_2 and not Hb_4. A number of molecules of this HbO_2 may then combine (or associate) with a suitable number of Hb molecules to give the various "intermediate compounds" of Pauling, Roughton and others, *viz.*, Hb_4O_2, Hb_4O_4, Hb_4O_6 and Hb_4O_8. This can be schematically represented as follows:

$$Hb_4 \rightleftharpoons 4\,Hb \overset{O_2}{\rightleftharpoons} 3\,Hb + HbO_2 \rightleftharpoons Hb_4O_2$$

$$\Downarrow O_2$$

$$2\,Hb + 2\,HbO_2 \rightleftharpoons Hb_4O_4$$

$$\Downarrow O_2$$

$$Hb + 3\,HbO_2 \rightleftharpoons Hb_4O_6$$

$$\Downarrow O_2$$

$$4\,HbO_2 \rightleftharpoons Hb_4O_8.$$

Thus, the intermediate compound hypothesis of oxyhæmoglobin fits well into the above scheme.

Starting from these postulates and applying the Law of Mass Action to the hæmoglobin-oxygen reaction under various conditions, the following equations have been derived for the various curves.

i) $$Y = 100K_1p/(1+K_1p)$$

for pure dialysed hæmoglobin, which is identical with the Hill's first equation.

ii) $$Y = (100-S)\,e^h \cdot \frac{K_1p}{1+K_1p}$$

for blood under the influence of pH and in presence of mineral salts.

iii) $$Y = \frac{100\,K_1p}{(1+K_1p)} \cdot \frac{(1+p)}{(1+p+K_2p')}$$

for blood at a carbon dioxide tension p'.

It can also be shown that these three equations are only the particular solutions of a more general equation given below, governing all the influencing factors, *viz.*, the presence of mineral salts, pH and the presence of carbon dioxide.

iv) $$Y = (100-S)\,e^h \cdot \frac{K_1p}{(1+K_1p)} \cdot \frac{(1+p)}{(1+p+K_2p')}$$

where Y is the observed oxygen absorption by blood or by pure dialysed Hb, S is a factor proportional to the mineral salt concentration, $h = (pH - pK)$ or $(eK - eH)$, p is the oxygen tension at equilibrium with blood, p' is the carbon dioxide tension at equilibrium with blood, and K_1 and K_2 are constants.

This equation has the unique advantage of governing all the factors influencing the

absorption of oxygen by blood. It involves only two constants and is much simpler than some of the previous equations containing as many as four constants. It is significant, as has been found, that most of the observed data for the oxygen absorption by blood under various physiological conditions fit into this equation in a very satisfactory manner.

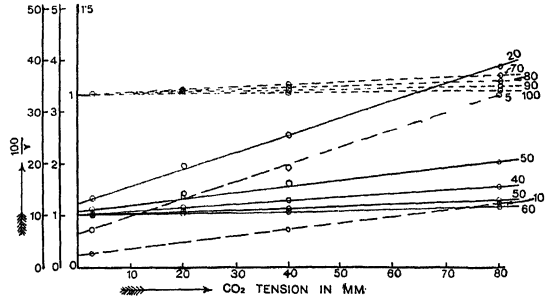


FIG. 1. The oxygen tension for each curve is marked at the end of the curve. The scale for 100/Y for tensions between 0 and 10 mm. is reduced 10 times to bring the curves within the size of the figure. The scale for 100/Y for tensions 70 mm. to 100 mm. is increased 10/3 times, to show them clearly without overlapping.

Thus, for instance, for a particular specimen of blood (*i.e.*, $h =$ constant and S = constant in the above equation) and at a definite oxygen tension (*i.e.*, $p =$ constant), equation (iv) can be directly transposed into the following equation, giving a linear relation between the carbon dioxide tension and the reciprocal of the oxygen absorption:

$$100/Y = \alpha + \beta p'$$

where, α and β are constants for a given oxygen tension, *i.e.*, Equation (*iv*) predicts that if 100/Y be plotted as ordinate against the corresponding p' as abscissæ at any constant oxygen tension, a straight line should be obtained for each oxygen tension. When the reciprocals of Y/100 (*i.e.*, of percentage oxygen absorption) from Henderson's *et al.*,[8] data are plotted against the corresponding carbon dioxide tensions (p'), it is found that the resulting points strictly lie in one straight line for each oxygen tension. The graphs are given in Fig. 1. This striking agreement between the predicted and the observed results not only proves beyond doubt the validity of the present equation, but it also shows that this equation holds good for the whole of the observed range of oxygen and carbon dioxide tensions, while the previous equations were reported to have proved less satisfactory at extreme oxygen tensions.[9]

Full details will be published elsewhere. The author thanks Dr. A. A. Aiyar of Stanley Medical College, and Prof. K. S. Srinivasa Varadan of the Madras Medical College, Madras, for their interest.

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NOBEL PRIZE FOR CHEMISTRY, 1955

THE Nobel Prize for Chemistry has been awarded to Prof. Vincent du Vigneaud, Professor of Biochemistry, Cornell University Medical College, New York. In announcing the award, the Swedish Academy of Sciences mentioned Prof. du Vigneaud's researches on biochemically important sulphur compounds, especially the first synthesis of a hormone which plays a significant role in the regulation of life processes.

Prof. du Vigneaud has carried out extensive research work on the chemistry of a number of complex substances of biological origin. In his book entitled *A Trail of Research in Sulfur Chemistry and Metabolism and Related Fields*, published in 1952, he has presented a very beautiful account of the biochemical research work carried out by him originating from a study of the chemistry of insulin and dealing with the conversion of methionine and homocystine to cystine, the participation of choline, betaine and related compounds in the process of transmethylation and the biosynthesis of 'labile' methyl groups. He has also collaborated during World War II with a number of scientists both in U.K. and U.S.A., in the study of the structure and later the synthesis of penicillin. His most important single piece of research, however, has been the working out of the structure of two hormones, produced by the posterior lobe of the pituitary gland, and later their synthesis. These two hormones are built up of the same components, *viz.*, amino acids, as are the proteins. But though the number of these amino acids in these hormones is relatively small in comparison to

proteins—8 in each case—their arrangement includes a ring structure, which makes their synthesis difficult. One of them, oxytocin, makes the uterus contract in childbirth while the other, vasopressin, constricts the blood vessels and increases the re-absorption of water by the tubules of the kidney. They were the first hormones of their kind to be synthesised. A further point of interest was that there were minor differences according to the animal by which the hormone was produced.

Prof. du Vigneaud has been Professor and Head of the Biochemistry Department in Cornell University Medical College since 1938. He has won a number of American awards for research including the award of merit for war research. He has, in addition, a large number of research publications to his credit and among his collaborators may be counted many scientists from different parts of the world, including a few from India.

P. S. SARMA.

NOBEL PRIZE FOR PHYSIOLOGY AND MEDICINE, 1955

THE Nobel Prize for Physiology and Medicine for 1955 has been awarded to the Swedish Biochemist, Prof. Axel Hugo Teodar Theorell for his pioneering work on the mechanism of cell respiration and on enzymes associated with biological oxidations.

Prof. Theorell who was born on July 6, 1903, was educated at the Karolinska Institute, Stockholm. After taking the M.D. Degree in 1930, he continued as a Docent in the Karolinska Institute until 1932 in which year he joined the Kaiser Wilhelm Institute for Cell Physiology as Rockefeller Foundation Fellow to work under the celebrated biochemist, Prof. Warburg. He soon showed himself to be a man of exceptional ability and his stay there was liberally punctuated with brilliant discoveries. Since 1937, he has been Professor of Biochemistry and Head of the Medical Nobel Institute, Stockholm.

It has long been recognised that the fundamental problem in cell respiration (*i.e.*, the utilization of molecular oxygen by the cell for the oxidation of organic metabolites) is the elucidation of the nature and mode of action of the catalytic systems on the presence of which the respiratory process is dependent. The epoch-making studies of Keilin, Warburg and others have brought to light the importance of carrier substances like cytochrome *c* and Warburg's flavoprotein in cell respiration. Prof. Theorell's early work was chiefly concerned with the establishment of the structure of cytochrome *c* and the crystallization of Warburg's 'old' yellow enzyme.

Pure cytochrome *c* was isolated for the first time by Prof. Theorell and his contributions to the problem of the constitution of cytochrome *c* represent a landmark in the chequered history of biochemistry as a separate discipline. Prof. Theorell found that in cytochrome *c* the hæmatin residue is united to the protein by means of thio-ether bindings of the hæmatin and also by 2-histidine imidazole groups.

No less outstanding is his work on the crystallization of the yellow enzyme and the nature of its coenzyme. He purified the yellow enzyme by cataphoresis at pH 4·2-4·5 and found it to be a chromoprotein. He was able to split off the coenzyme from the protein moiety (apoenzyme) by dialysis against dilute hydrochloric acid at 0-2° C. He succeeded in preparing the coloured prosthetic group in crystalline form as the calcium salt and identified it as the monophosphoric acid ester of riboflavin. This experiment noted for its classical simplicity, revolutionized the concept of coenzymes in general and had a profound influence on subsequent biochemical research.

Prof. Theorell has also made important contributions on the nature of action of catalase and in the crystallization of horse-radish peroxidase and lacto-peroxidase. His extensive studies on the physical properties and chemical nature of the hydroperoxidases represent the spearhead of present research and has paved the way for launching studies of their enzyme-substrate compounds. The recent work of Prof. Theorell on these enzymes has a distinct physico-chemical bias and his magnetic susceptibility studies of the alkaline forms of horseradish peroxidase, ferrimyoglobin and ferrihemoglobin indicate the non-identity of the electronic structure of these substances.

Besides this, Prof. Theorell has been responsible for the preparation of a crystalline lipoxidase from soya beans and in the development of a spectrophotometric method for the assay of lipoxidase.

His interest in the problem of cell respiration and other cognate fields has continued with unabated vigour and it is no exaggeration to state that his scientific career has throughout been a catalogue of brilliant researches and notable achievements.

K. V. GIRI.
C. S. VAIDYANATHAN.

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THE ELASTIC SCATTERING OF HIGH ENERGY ELECTRONS BY BERYLLIUM

The nuclear scattering of 125 Mev electrons by beryllium has been observed by Hofstadter, Fechter and McIntyre[1] who have attempted to correlate the same on the basis of various assumed nuclear charge density distributions. Schiff[2] has also carried out a similar analysis. Gatha, Patel and Patel[3] have dealt with this experimental data on the basis of a nuclear density distribution determined by Gatha, Shah and Patel.[4] Recently, McIntyre, Hahn and Hofstadter[5] have observed the nuclear scattering of 190 Mev electrons by beryllium. In the meanwhile, Gatha and Shah[6] have improved upon their previous analysis of the experimental data on the nuclear scattering of 340 Mev protons and obtained an improved characteristic nuclear density distribution given by

$$\rho(\bar{r}) = a_1 \exp(-b_1\bar{r}^2) + a_2 \exp(-b_2\bar{r}^2)\{1 - b_3\bar{r}^2 + b_4\bar{r}^4\} \quad (1)$$

where,

$a_1 = 0{\cdot}12\times10^{39}$ cm.$^{-3}$, $a_2 = 0{\cdot}25\times10^{39}$ cm.$^{-3}$,
$b_1 = 8{\cdot}62\times10^{26}$ cm.$^{-2}$, $b_2 = 1{\cdot}09\times10^{26}$ cm.$^{-2}$,
$b_3 = 0{\cdot}44\times10^{26}$ cm.$^{-2}$, $b_4 = 0{\cdot}13\times10^{52}$ cm.$^{-4}$,

while $\bar{r} = rA^{-\frac{1}{3}}$, where A is the nuclear mass number. In the present investigation, the above experimental data on nuclear scattering of 125 Mev and 190 Mev electrons by beryllium have been analysed on the basis of the above characteristic nuclear density distribution.

The Born approximation can be taken to be reasonably valid in treating the nuclear scattering of high energy electrons by light nuclei.

In this approximation, the scattering cross-section is given by

$$\sigma(s) = (1-\beta^2 s^2/4k^2) \mid f(s) \mid^2 \qquad (2)$$

where

$$sf(s) = -\int_0^\infty U(r) \sin(sr)\, r\, dr \qquad (3)$$

with

$\beta = v/c$, $s = 2k \sin(\theta/2)$, $U(r) = 2\,EV(r)/(\hbar c)^2$

Following Mathur and Gatha,[7] one can express the scattering amplitude in terms of the nuclear density distribution. For a characteristic nuclear density distribution, one can introduce the form-factor $g(\bar{s})$ as

$$\bar{s}g(\bar{s}) = \int_0^\infty \rho(\bar{r}) \sin(\bar{s}\bar{r})\, \bar{r} d\bar{r} \qquad (4)$$

where $\bar{s} = sA^{\frac{1}{3}}$. The form-factor is then related to the cross-section as

$$\sigma(\bar{s}) = \left(1 - \frac{\beta^2\bar{s}^2}{4k^2A^{2/3}}\right) \left\{\frac{8\pi EZe^2A^{2/3}}{(\hbar c)^2\,\bar{s}^2}\, g(\bar{s})\right\}^2 \qquad (5)$$

Substituting in equation (4), the expression for $\rho(\bar{r})$ from equation (1), one obtains

$$g(\bar{s}) = \alpha_1 \exp(-\beta_1\bar{s}^2) + \alpha_2 \exp(-\beta_2\bar{s}^2)\{1-\beta_3\bar{s}^2+\beta_4\bar{s}^4\} \qquad (6)$$

where

$\alpha_1 = 0{\cdot}0022$ mb., $\alpha_2 = 0{\cdot}0078$ mb.

$\beta_1 = 0{\cdot}29 \times 10^{-26}$ cm.^{2}, $\beta_2 = 0{\cdot}23 \times 10^{-26}$ cm.^{2}

$\beta_3 = 0{\cdot}04 \times 10^{-26}$ cm.^{2}, $\beta_4 = 0{\cdot}0075 \times 10^{-52}$ cm^4.

The theoretical form factor $g(\bar{s})$, calculated from equation (6) is shown in Fig. 1. The experimental form factors, both for 125 Mev and 190 Mev were calculated from the given experimental values of $\sigma(\bar{s})$ by using equation (5). Since the measured values of $\sigma(\bar{s})$ are only relative values, the experimental form-factors for each energy have been multiplied by an appropriate constant to bring it in agreement with the theoretical form factor. It turns out that the measured cross-sections have to be multiplied by 0·00058 mb at 125 Mev and by 0·0010 mb at 190 Mev to convert them into absolute cross-sections. It is clear from Fig. 1 that there is a reasonable agreement between the theoretical and the experimental form factors.

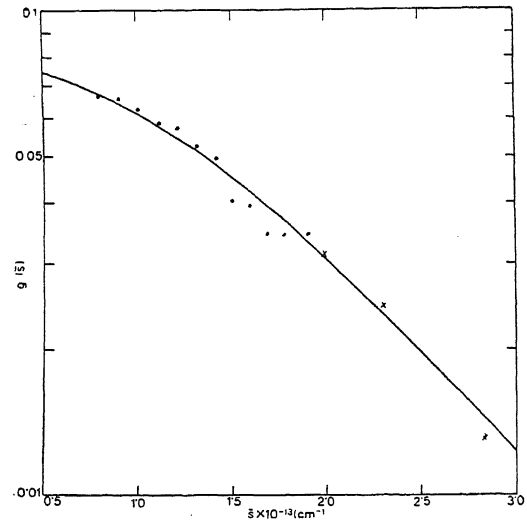


FIG. 1. The full curve represents the theoretical form-factor, while the dots and crosses represent the xperimental form-factors for 125 Mev and 190 Mev espectively.

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THE NUCLEAR SCATTERING OF 14 MEV NEUTRONS

Amaldi, Bocciarelli, Cacciapuoti and Trabacchi[1] have observed the nuclear scattering of 14 Mev neutrons. They have measured the total scattering cross-sections for various nuclei from which they have calculated the nuclear radii, on the basis of an opaque nuclear model, by using the approximate expression :

$$\sigma_t = 2\pi R^2 \qquad (1)$$

where σ_t = total scattering cross-section, and
R = the nuclear radius.

These nuclear radii were found to obey the relation :

$$R = (R_0 + \bar{R}A^{\frac{1}{3}}) \qquad (2)$$

where

$R_0 = (1{\cdot}5 \text{ to } 2{\cdot}0) \times 10^{-13}$ cm.

$\bar{R} = (1{\cdot}0 \text{ to } 1{\cdot}3) \times 10^{-13}$ cm.

A subsequent analysis of the same data by Fernbach[2] led to $R_0 = 1{\cdot}22 \times 10^{-13}$ cm. and $\bar{R} = 1{\cdot}37 \times 10^{-13}$ cm. It is interesting to note here that an analysis with the same order of approximation, of the experimental data, on the nuclear scattering of 90 Mev neutrons on the basis of a transparent nuclear model, by

Fernbach, Serber and Taylor[3] leads to $R_0 = 0$. Thus it is unlikely that the intercept R_0 is an inherent property of the nuclear radius. Attempts have been made to relate R_0 with the wafe-length of the incident particle as described by Mott and Massey.[4] These indicate that R_0 arises as a result of using the approximate expression given in equation (1), for the nuclear scattering of 14 Mev neutrons.

The nuclear radii have been calculated in the present investigation, from the experimental data of Amaldi *et al.*,[1] by using the exact expression

$$\sigma_t = \frac{4\pi}{k^2} \sum_{l=0}^{\infty} \frac{(2l+1)\, j_l^2\,(kR)}{j_l^2(kR)+n_l^2\,(kR)} \qquad (3)$$

where j_l and n_l are spherical Bessel functions of the first and second kinds respectively, while k is the magnitude of the propagation vector of the incident wave. A least square fit of equation (2) for the nuclear radii, presented by Amaldi *et al.*,[1] give $R_0 = (1{\cdot}11 \pm 0{\cdot}26) \times 10^{-13}$ cm. and $\bar{R} = 1{\cdot}42 \times 10^{-13}$ cm. A similar calculation, using the nuclear radii obtained in the present investigation, leads to $R_0 = (0{\cdot}57 \pm 0{\cdot}26) \times 10^{-13}$ cm. and $\bar{R} = 1{\cdot}32 \times 10^{-13}$ cm. The probable errors on $\bar{R}$ are negligible in both these calculations. Repeating these calculations, while considering the probable errors on nuclear radii, leads to about the same values for R_0 and $\bar{R}$.

Thus it is clear that an exact analysis of the experimental data on the nuclear scattering of 14 Mev neutrons, on the basis of an opaque nuclear model significantly reduces the magnitude of R_0. However, such a calculation does not make R_0 vanish completely. This may, perhaps, be due to some systematic error in the experimental data of Amaldi *et al.*[1] On the other hand, this may also indicate the inadequacy of the opaque nuclear model, with uniform density distribution, for correlating the experimental data on the nuclear scattering of 14 Mev neutrons.

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ULTRASONIC RELAXATION IN AQUEOUS SOLUTIONS OF N_2O_4

Ultrasonic absorption measurements in aqueous solutions of sulphur dioxide and sulphites have revealed the existence of a relaxation phenomenon.[1] The existence of this phenomenon in solution was ascribed to the disturbance in the chemical equilibrium between the sulphurous acid and its individual ions in solution in the presence of the ultrasonic beam. To prove this point further, the present work has been undertaken.

Nitrogen tetroxide gas has been thoroughly studied by Richards and Reid[2,3] and it is known to exhibit a frequency of peak absorption in the region of 400 Kc/s as compared to about 1 Mc/s for SO_2 gas. In aqueous solution, N_2O_4 undergoes a chemical change and a dynamic equilibrium is set up as indicated by the equations[4]

$$N_2O_4 + H_2O \rightarrow HNO_2 + HNO_3$$
$$HNO_2 \rightleftharpoons H^+ + NO_2^-.$$

On an analogy with SO_2 solutions, the aqueous solutions of N_2O_4 also must exhibit peaks of absorption but at a frequency lower than those of the former. The ultrasonic absorption is measured using the pulse technique of Pellam and Galt with the modification that a second crystal is used as receiver instead of a reflector. The temperature is held constant at 29° C. to within ± 0·5° C. and attenuation measurements are accurate to within ± 5%.

The gas, prepared by the action of dilute HCl on sodium nitrate, is passed through water. The strengths of the solutions are determined by a standard method of titration. Only dilute solutions have been used in these experiments to ensure constancy of concentration during ultrasonic observation and also to avoid bubbles of gas forming within the liquid under ultrasonic excitation. A number of concentrations have been studied but only a representative set of results is given in Fig. 1.

From the figure, it will be seen that the results are very similar to those in sulphur dioxide. The frequency of peak absorption increases with increasing concentration upto a limit after which it becomes independent of concentration. As the observations are confined to the Fresnel region of the ultrasonic beam, frequencies below 2 Mc/s could not be employed.

Sodium nitrite solutions also exhibit this phenomenon confirming the fact that it is NO_2^- ion that is responsible for this effect.

Preliminary experiments dealing with the effect of temperature on the peak absorption

frequency also confirm that there is a close relation between this frequency and the rate of chemical reaction going on in the solution.

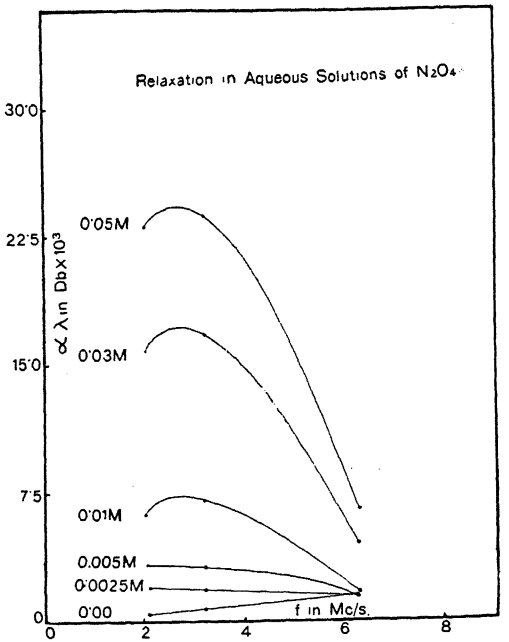


FIG. 1.

Fuller results of this work will be published separately.

The authors thank Professor S. Bhagavantam for his interest and guidance during the course of this work.

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CONFIGURATION INTERACTION IN $^1\Sigma^+_g$ STATE OF H_2 MOLECULE

THERE is a close analogy between the way in which appropriate H-atom-like wave functions can be used for building up wave functions for atomic He and the way in which H_2^+-ion-like wave functions can be used for building up wave functions for molecular H_2; this analogy has been noted by Mulliken[1] who has suggested several lines of work regarding the computation of configuration interaction in H_2 molecule. A detailed calculation by Taylor and Parr[2] has exhibited the accuracy that can be attained by a proper choice of H-like functions for treating configuration interaction in the case of atomic He.

No calculations of configuration interaction for molecular H_2 have been made so far, following the analogy noted above. A programme has been undertaken by the author to study configuration interaction in H_2 molecule, at various internuclear distances, using single electron wave functions which arise in the solution of the H_2^+ problem. The following is a preliminary notice of the computation made for the energy at the equilibrium nuclear distance, namely, 1·4 atomic units (a.u.). The energy which the author has calculated at 1·4 a.u. is lower than any other value reported so far. It is even lower than the value −2·3154 a.u. which James and Coolidge[3] have thought to be the best possible without the explicit introduction of the interelectronic distance in the wave function.

In terms of the usual confocal elliptical coordinates, the three configurations used were

$$(1s\sigma)\ (1s\sigma)' : \psi_1 = e^{-\delta(\xi_1+\xi_2)} [1+p(\xi_1+\xi_2)+r\xi_1\xi_2](1+c\eta_1^2)(1+c\eta_2^2)$$

$$(2p\sigma)^2 : \psi_2 = e^{-\lambda(\xi_1+\xi_2)}[\eta_1\eta_2]$$

$$(2p\pi)^2 : \psi_3 = e^{-\mu(\xi_1+\xi_2)}[(\xi_1^2-1)(\xi_2^2-1)(1-\eta_1^2)(1-\eta_2^2)]^{\frac{1}{2}}\cos(\phi_1-\phi_2)$$

In the $(1s\sigma)\ (1s\sigma)'$ configuration it was found more convenient to open out the shell by taking p and r as shown, rather than by taking two exponentials δ and δ'; for the sake of avoiding unduly elaborate computations, λ and μ were taken equal to $\delta = 0{\cdot}75$, which is the James and Coolidge exponential at 1·4 a.u.

The results of the calculations with ψ_1, ψ_2 and ψ_3 given above are as follows:

(*i*) Using ψ_1 only and taking $\delta = 0{\cdot}75$, the energy was found to be minimum when $p = 0{\cdot}01134$, $r = -0{\cdot}03693$ and $c = 0{\cdot}255$, the minimum value being −2·2727 a.u.

(*ii*) Using ψ_1, ψ_2 and ψ_3, taking $\delta = \lambda = \mu = 0{\cdot}75$, $p = 0{\cdot}01134$, $r = -0{\cdot}03693$ and $c = 0{\cdot}255$ the minimum value of the energy is −2·318 a.u.

The value computed by James and Coolidge with their 13 term wave function is −2·3470 a.u. Thus the correlation energy is more than halved in including the 'angular' configuration $(2p\sigma)^2$ and $(2p\pi)^2$ and a very close agreement with the actual energy has been obtained by taking one electron molecular orbital functions of the type $(1s\sigma)$, $(2p\sigma)$ and $(2p\pi)$. Of course a certain amount of advantage has been lost in taking $\delta = \lambda = \mu$ which means the

the value — 2·3180 a.u. can be pushed further towards the best value of James and Coolidge.

Similar calculations at smaller internuclear distances are in progress and details will be published separately.

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INTRA-STRATAL SOLUTIONS AND HEAVY MINERAL FREQUENCY IN SEDIMENTARY ROCKS

THE present paper details the results of study of heavy minerals in the sedimentary rocks of Nuzvid area (E. Long. 80° 51′ 30″ and 81° 0′, N. Lat. 16° 45′ and 17° 0′). The geological formations are Rajahmundry sandstones, Gollapalli sandstones, Chintalapudi sandstones and Khondalites.

Five samples from the Chintalapudi stage, twelve from Gollapalli horizon and four from the Rajahmundry formation were studied for their heavy minerals, following the standard petrographic methods. Frequencies of the individual minerals after Evans, Hayman and Majeed[1] were calculated from the percentages. Table I gives the average composition of each stage on heavy mineral basis (magnetite-free).

TABLE I

	Chintalapudi	Gollapalli	Rajahmundry
Zircon (Yellow)	5	6	6
Zircon (Colourless)	7	7	
Rutile	6	4	5
Staurolite	..	4	4
Sphene	..	4	..
Kyanite	..	2	6
Garnet	2	3	5
Hypersthene	..	1*	2
Sillimanite	..	..	5
Epidote	..	..	1

* Represents less than 0·5%.

A general study of the mineral assemblages of the three formations from the above table reveals two striking features: (1) there is an enrichment of heavy minerals in the younger formations; and (2) epidote and hypersthene, termed as comparatively unstable by Goldisch[2] and Pettijohn[3] are absent from the Chintalapudi stage, but are persistent in the Tertiary rocks. It is suggested that these phenomena are due to the effect of intra-stratal solutions, after Pettijohn,[3] Boswell[4] and Crook.[5]

The author is indebted to Prof. C. Mahadevan for helpful guidance and criticism.

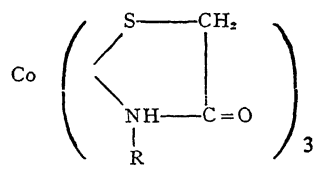
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COMPLEX OF TRIVALENT COBALT WITH *p*-(MERCAPTOACETAMIDO)-BENZOIC ACID

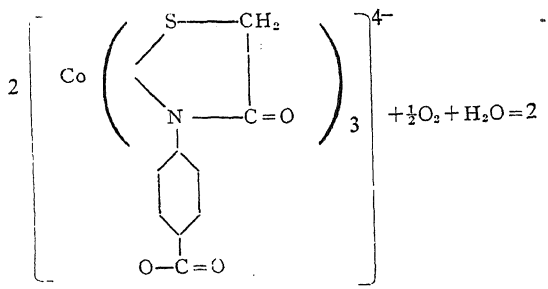
SOME derivatives of thioglycollanilide have been successfully used for the formation of complexes of cobalt.[1] The reagents can be represented by R-NH.CO.CH_2.SH, where R is a phenyl or substituted phenyl group. Some of the complexes obtained are soluble whereas others are insoluble. The analysis of the insoluble compounds obtained with cobalt indicated that the complexes contain three ligands per atom of cobalt. It was therefore concluded that — NH.CO.CH_2.SH group serves as a bidentate group. The solubility in water of the other complexes obtained with cobalt were due to the presence of carboxyl groups in the phenyl ring.

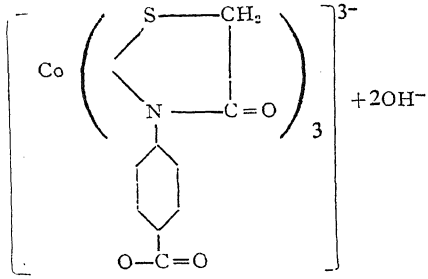
The insoluble cobalt complexes are therefore inner complexes. The primary conditions for the formation of inner complex is that the chelates should satisfy the co-ordination number and valency of the central atom. Hence cobalt was assumed to be trivalent and the ligand to be bidentate containing one negative and one neutral group and expressed by the structure



There is however no definite evidence that cobalt is trivalent and the chelates are bidentate. It was therefore thought worthwhile to investigate the above problem by magnetic measurement.

p-(Mercaptoacetamido) benzoic acid contains — NH.CO.CH_2.SH group. The reagent is





soluble in alkali giving a colourless solution. An intense pink colour is produced when the alkali solution of the reagent is mixed with a solution containing divalent cobalt. This complex is expected to have a structure similar to the above.

If cobalt is trivalent and the co-ordination number is six, the compound would be diamagnetic. A known amount of cobalt sulphate was used with just excess of an alkaline solution of the reagent. The magnetic measurements were made with a magnetic balance. The compound was found to be *para*-magnetic at the beginning. The *para*-magnetism however decreased with time and after three hours the compound was found to be diamagnetic.

This indicates that the compound which is ultimately formed contains six co-ordinated trivalent cobalt. A divalent cobalt complex is probably formed at the beginning since cobalt hydroxide is not formed though an excess of alkali is present in the alkali solution of the reagent. The reaction can be represented by the structure given above.

Due to the oxidation of the cobaltous complex to cobaltic by oxygen of the air (which is the only available oxidising agent) the pH of the solution is expected to rise. This has been qualitatively observed.

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CRITICAL TEMPERATURE—BOILING POINT RELATION IN ALIPHATIC HYDROCARBONS

THE earliest and the simplest empirical formulæ connecting critical temperature, boiling point, and number of carbon atoms of normal hydrocarbons is due to Guldberg[1] and Guye.[2]:

$$T_b/T_c = 2/3$$

But this relation is very approximate. Ferguson[3] has correlated T_c, T_b and n by the formula:

$$T_c n^g = hT_b \qquad (1)$$

$$\log T_b = \log T_c + g \log n - a \qquad (1\,a)$$

where g, h and a are constants. But this formula is also of approximate nature. It can be further modified by introducing another constant. Thus the formula is:

$$c \log T_b = \log T_c + g \log n - a \qquad (2)$$

Table I records the observed and calculated value of T_b by equation (2). Values of the constants are: $a = 1{\cdot}106$; $c = 0{\cdot}60922$ and $g = 0{\cdot}07143$.

Data have been taken from *Landolt Bornstein Tables* and the *Handbook of Chemistry and Physics*.

For the first few members, an anomalous result is obtained which is due to the fact that most of the physical properties of the earlier members of the organic series do not tally with the regular behaviour of the higher members.

TABLE I

n	Paraffins	Temperature in deg. absolute		
		T_c (obs.)	T_b (obs.)	T_b (cal.)
1	Methane	190·7	111·5	84·92
2	Ethane	305·3	184·7	182·0
3	Propane	368·8	230·9	220·3
4	Butane	426·2	272·6	269·8
5	Pentane	470·4	309·1	309·0
6	Hexane	508	342	342·8
7	Heptane	540	371·5	372·4
8	Octane	569·4	397·6	399·0
9	Nonane	595·4	423·6	423·6
10	Decane	619·3	447	447·7
11	Uudecane	642·6	470	469·5
12	Dodecane	663·8	489	489·8
13	Tridecane	683·2	507	508·8
14	Tetradecane	701	525·5	524·8
15	Pentadecane	717·6	543·5	543·3
16	Hexadecane	734·3	560·5	559·8
17	Heptadecane	749·3	576	575·4
18	Octadecane	763·2	590	589·5
19	Nonadecane	776	603	603·9

The author acknowledges his indebtedness to Prof. S. Ghosh and Sri. S. S. Mitra for their kind help and suggestions in the investigation.

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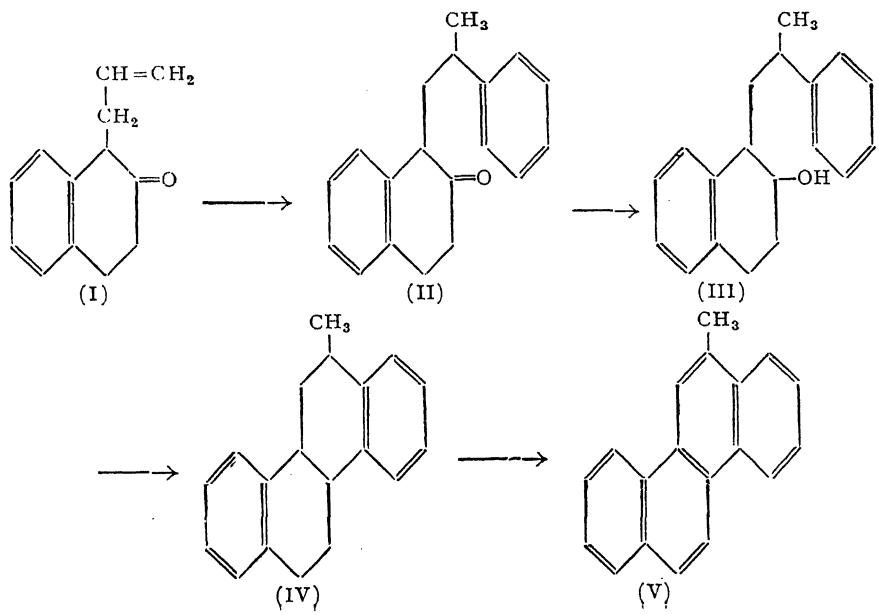
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A NEW SYNTHESIS OF 2-METHYL CHRYSENE

CATIONOID reactions between aromatic nuclei and γ, δ-unsaturated ketones and esters have been extensively employed in this laboratory to enable easy access to a wide variety of polycyclic aromatic hydrocarbon derivatives of naphthalene,[1] phenanthrene,[2] anthracene,[3] 3 : 4-benzphenanthrene,[4] and 1 : 2-benzanthracene[5] series. The present communication reports a new synthesis of the chrysene system by a modification of the unsaturated ketone component in the alkylation reaction leading to an improved synthesis of 2-methyl chrysene.

β-Tetralone was allylated with allyl iodide in boiling benzene in presence of dry sodamide prepared *in situ*, when 1-allyl-2-tetralone (I) was obtained in 61% yield as a colourless mobile liquid, b.p. 140-45°/5 mm. (Calc. for $C_{13}H_{14}O$: C, 83·83; H, 7·58. Found : C, 84·12; H, 7·48.) The ketone (I) failed to furnish any solid 2 : 4-dinitro-phenylhydrazone or semicarbazone by the usual method and underwent oxidation on keeping. 1-allyl-2-tetralone (I) on being subjected to aluminium chloride catalysed condensation with thiophene-free benzene at 0-5° yielded 1-[β-methyl-β(phenyl)-ethyl]-2-tetralone (II) as a colourless viscous oil, b.p. 240-45°/6 mm. in 56% yield. (Calc. for $C_{19}H_{20}O$: C, 86·32; H, 7·63. Found : C, 86·10; H, 7·62.) The alkylated product (II) was reduced with aluminium isopropoxide in isopropyl alcohol to obtain 1-[β-methyl-β(phenyl)-ethyl]-2-tetralol (III) as a viscous tan mass in 72% yield, b.p. 225-30°/5 mm. (Calc. for $C_{19}H_{22}O$: C, 85·67; H, 8·33. Found : C, 86·17; H, 7·88.) Cyclisation of the carbinol (III) was effected with conc. sulphuric acid (sp. gr. 1·84) when 1 : 2 : 7 : 8 : 15 : 16-hexahydro-2-methyl chrysene (IV) was obtained in 58% yield, b.p. 220-25°/5 mm. (Calc. for $C_{19}H_{20}$: C, 91·88; H, 8·12. Found : C, 91·54; H, 8·00.) The above hexahydro-derivative was then aromatized over 30% palladium-on-charcoal catalyst to obtain a resinous product distilling at 215-20°/4 mm. in 55% yield. 242 mg. of the above furnished 385 mg. of a dark red picrate which crystallised from benzene-alcohol mixture in orange needles, m.p. 169-70° (lit.[6] m.p. 170-70·6°). (Calc. for $C_{25}H_{17}O_7N_3$: N, 8·91; Found : N, 8·95.) 2-methyl chrysene (120 mg.) was regenerated from the above



(I) (II) (III) (IV) (V)

picrate (385 mg.) and crystallised from light petroleum ether (b.p. 40-60°) in colourless leaflets, m.p. 160° (lit.[6] m.p. 161-61·4°). (Calc. for $C_{19}H_{14}$: C, 94·18; H, 5·82. Found: C, 93·86; H, 5·75).

Microanalysis by Drs. Weiler and Strauss, Oxford.

Dept. of Chemistry, Panjab University, Hoshiarpur, *June* 13, 1955.

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M. L. VASHISHT.
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SOME SEROLOGICAL OBSERVATIONS ON THE BLOOD OF THE INDIAN COBRA (*NAIA TRIPUDIANS*)

SEROLOGICAL studies of snake blood have so far been confined to Europe and America.[1-5]

As far as is known no similar studies of the blood of the Indian cobra, *Naia tripudians*, have been made. Blood from two Indian cobras having become available, it was decided to investigate their serological interactions with human blood.

Washed 2% suspensions of cobra erythrocytes were tested with the following human sera; B (anti-A), A (anti-B), O (anti-A + B), AB; at room temperature; anti-P at 4° C.; anti-D and anti-C, anti-E, anti-c, anti-e, at 37° C.; and also with rabbit anti-M and anti-N at 4° C. The interactions are recorded in Table I.

From the negative reactions with human AB sera, and rabbit anti-M and anti-N sera, it appears that human and rabbit sera do not contain species agglutinins for cobra erythrocytes. Cobra erythrocytes appear to contain human A- and B-like antigens as they are agglutinated by human anti-A and anti-B sera. These antigens, however, are weak and it is noteworthy that cobra red cells are more strongly agglutinated by O sera (anti-A + B) than by anti-A or anti-B. by O sera (anti-A + B) then by anti- or anti-B. This is a well-known property of the weaker forms of the human A agglutinogen. A human P-like antigen also seems to be present.

TABLE I

Reactions of various human and rabbit antisera with cobra erythrocytes

Serum (undiluted)	Agglutination reactions with cobra erythrocytes	
	Cobra I	Cobra II
anti-A ..	+	W
anti-B ..	W	W
anti-(A + B) ..	+++	++
AB ..	–	–
anti-P ..	W	W
anti-D ..	–	–
anti-C ..	–	–
anti-E ..	–	–
anti-c ..	–	–
anti-e ..	–	–
anti-M ..	–	–
anti-N ..	–	–

+++ = Fairly large agglutinates visible macroscopically: + = Weak agglutination seen macroscopically; W = Small agglutinates seen microscopically; – = No agglutination seen microscopically.

The sera of the cobras were inactivated and tested against a panel of human erythrocytes (2% washed cells suspended in isotonic saline) at 4° C., laboratory temperature, and 37° C. The serum of Cobra I when completely absorbed with O cells, failed to agglutinate A_1 and A_2 cells, but agglutinated B cells weakly in the cold. It appeared to contain a species agglutinin for human erythrocytes as well as anti-B agglutinin. The serum of Cobra II when similarly treated seemed to contain species agglutinins as well as agglutinins for human A and B cells. These could be separated by absorption with A or B cells, that is, the serum contained both anti-A- and anti-B-like antibodies. The presence of anti-B in the serum of Cobra I and anti-A and anti-B in the serum of Cobra II is not surprising in view of the weakness of the A- and B-like antigens in the cobra erythrocytes. The co-existence of A- and B-like antigens with cold anti-A and anti-B agglutinins (for human erythrocytes) in a cold-blooded creature possibly indicates that the A- and B-like antigens of the cobra are not identical with human A and B respectively.

Blood Transfusion Dept., Armed Forces Medical College, Poona, *September* 8, 1955.

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NAIL-HOLDING POWER OF A FEW MYSORE WOODS

THE Forest Research Laboratory, Bangalore, has a Universal "Timber" Testing Machine made by Mohr and Federhaff, Mannheim, Germany, for testing small clear specimens of timber. The makers describe the various tests to which the machine can be adapted; nail-holding capacity is, however, not amongst the adaptations suggested. The present paper describes an adaptation of the machine for this purpose, and the experimental results obtained with some Mysore woods.

The machine has two U-shaped grip heads, the one inverted attached to the movable head, and the other fixed by the bottom movable rod. Two rectangular steel plates $3\frac{1}{8}'' \times 1\frac{7}{8}''$ with thickness of $\frac{1}{8}''$ or $\frac{1}{4}''$ with suitably bevelled edges and a hole in the middle that would allow the nail to pass but not its head are placed over the wood specimen ($1\frac{3}{4}'' \times 1\frac{3}{4}'' \times 3''$) to be tested; a 2" nail of 12 S.W.G. was driven through the holes of the steel plates into the wood either 1" or $1\frac{1}{4}''$ deep, exclusive of the point, as required in the experiment. After driving the nail, the steel plates separated from one another are placed in the two grip heads. The machine head was then run at a uniform speed of 10 mm. per minute till the maximum load required for withdrawal of the nail was recorded.

All the thirty-three species of woods tested were air-seasoned. Owing to paucity of properly air-seasoned wood the number of specimens tested was limited to 6-24.

It was found that in general denser woods offer greater resistance to direct withdrawal of nails than less dense woods. Among the variations in this general rule mention may be made of *Elæocarpus serratus*, which is about 50% stronger than *Grevillea robusta* in nail-holding power though both of them have almost the same specific gravity and moisture content. *Holigarna arnottiana* though lighter than *Grevillea robusta* has almost the same nail-holding power as the former. Again, though the specific gravity of *H. arnottiana* is lower than that of *Ailanthus malabarica*, its nail-holding power is superior to that of the latter. Such variations may be attributed to other characteristics of the species.[1]

In these experiments it is interesting to note that woods having oil in them, such as *Santalum album*, *Tectona grandis* and *Machilus macrantha*[3] have low values for nail-holding power, when compared with woods of similar specific gravity. The effect of oil in wood on the nail-holding power is worth further investigation.

The denser woods are found to have a tendency to develop cracks and split while nailing. This tendency is aggravated in "exceedingly" heavy woods like *Soymida febrifuga* and *Hardwickia binata*. It is also observed that light woods such as *Ailanthus malabarica*, *Cedrela toona*, *Elæocarpus tuberculatus*, *Holigarna arnottiana*, *Hymenodictyon excelsum*, *Kydia calycina* and *Salmalia malabarica* have comparatively low nail-holding power; they have less tendency to crack and split, and hence are capable of taking greater number of nails than denser woods. Nail-holding power of woods has shown improvement when the nail is driven to a greater depth into the wood. It is also observed that resistance to withdrawal is greater when nails are driven into the side grain than when driven in the end grain of wood.[2]

Fig. 1 is a curve obtained by plotting the nail-holding power of different species of woods

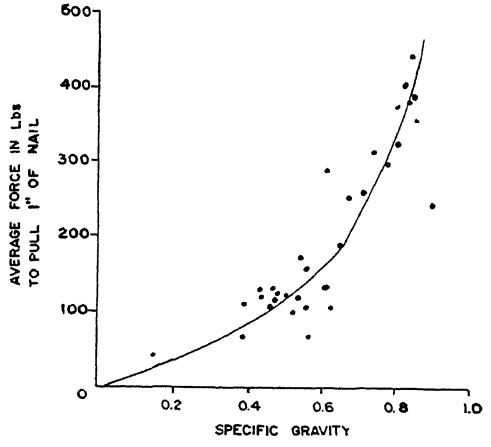


FIG. 1. Relation between specific gravity and nail-holding power. 12 gauge 2" nails driven 1" deep into the side grain of well air-seasoned wood and pulled at once.

tested, against their specific gravities. With the help of the curve the nail-holding power of other woods, which have not been tested, can be roughly estimated if the specific gravity of the wood concerned is known.[1]

The author is thankful to his colleagues, Dr. M. N. Ramaswamy for his suggestions, and D. Range Gowda for determining specific gravities of specimens.

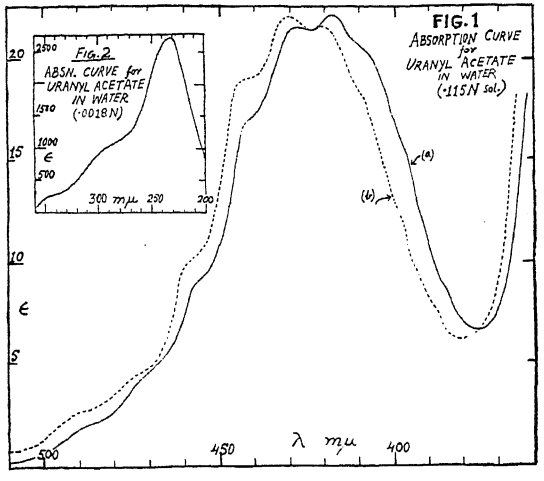
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INTENSITY MEASUREMENTS IN ABSORPTION AND FLUORESCENCE OF URANYL ACETATE SOLUTION

ABSOLUTE intensity measurements in absorption spectra of uranyl acetate solution in water under various dilutions have been taken in the range 5000-2000 Å. Intensity distribution in the fluorescence spectrum has also been investigated.

In strong solutions the curve upto 3800 Å (Fig. 1, *a*) resembles the curve for uranyl



FIGS. 1 & 2. Intensity measurements of absorption of uranyl acetate solution.

nitrate solution.[1] The vibration-like structure, although less pronounced, can yet be recognised as having nine peaks with the average band separation $\Delta\nu \sim 670$ cm.$^{-1}$ The inequalities of $\Delta\nu$ are markedly larger, and the structure, which in the nitrate extends upto 3480 Å, is entirely missing here below 3750 Å, from where a continuum sets in. In the banded region the absorption maximum in strongest solutions is at 4170 Å, but the 4270 Å band, which is only a little less intense, gains definitely over the 4170 Å band with increasing dilution. The absorption curve in the ultraviolet (Fig. 2), observed with very dilute solutions, shows a continuum with three regions of peak absorption at 3400 Å, 2900 Å and 2300 Å. The last one probably wholly belongs to the acetate ion. The values of molal extinction coefficient ϵ at 4270 Å, 3400 Å, 2900 Å (and 2300 Å) are respectively 59, 270, 1020 (and 2720) with ·0018 N solution. At the maximum absorption band (4270 Å) the acetate solution absorbs 5 times compared to the maximum absorption band in the nitrate solution. The ultraviolet continua obviously pertain to different electronic transitions, which have higher transition probability than that associated with flouresence emission. It is found that for concentrations varying from 0·115 to ·0018 N, under which absorption in the visible region has been observed, Beer's law is not obeyed, although the nature of the curve remains unaltered, the deviation being largest for the 4270 Å band.

Another sample of uranyl acetate, a Swedish product not of the A.R. grade, gave an absorption curve (Fig. 1, *b*) similar to the one described above, except that there was shift of the entire curve towards the shorter λ side by about 30 Å. In the fluorescence of solutions the continuum[2] is similar for the two samples, but while the peak for the A.R. grade falls at 5200 Å, that for the other is shifted 30 Å to the longer λ side. It is interesting, however, that in the solid state the fluorescence spectra of the two samples show a very marked difference. The Swedish product gives a spectrum shifted to the ultraviolet by about 110 Å, and several other differences both with regard to intensity distribution in the bands and in the nature of spectra have also been observed.

Details will be published elsewhere.

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ASSAY OF ROOT EXUDATES

RECENT studies on root exudates[1] have opened up a new field of investigation in understanding rhizosphere activity.[2] In this field of enquiry two promising techniques have been evolved and they are reported hereunder.

The first technique consisted of growing plants (*Eleusine coracana* Gærtn., *Oryza sativa* Linn., *Phaseolus mungo* Linn., *P. radiatus* Linn., and *Cicer arietinum* Linn., were used by us for our preliminary observations) from seeds previously surface sterilized and germinated on sterile agar and planted in sterile 1/10 N Richard's solution without sucrose (using Analar chemicals) in Roux tubes. The seedlings were allowed to grow for a fortnight after which the liquid substratum was withdrawn and autoclaved in culture flasks with addition of 0·5% sucrose. A strain of *Piricularia oryzæ* Br. et Cav., heterotrophic to thiamine and biotin[3,4] used in previous investiga-

tions in this laboratory was then seeded in this substratum. Aliquots of 1/10 N Richard's solution in which no plants were grown, with the addition of 0·5% sucrose, served as control. The fungus was observed to grow well in media in which plants had grown, but not in the controls. This is suggestive of the presence of root exudates having thiamine-biotin replacement value. The value of this technique is

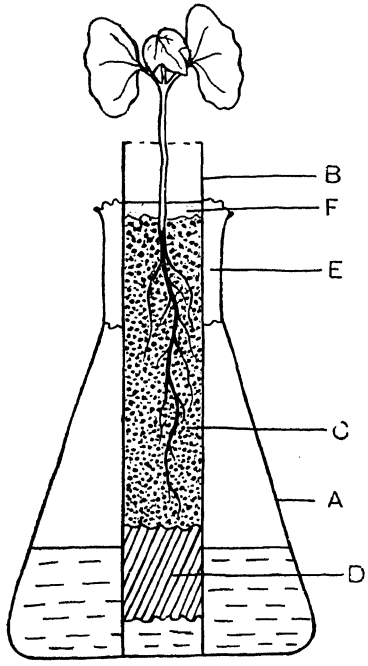


FIG. 1.

mainly its simplicity and adaptability to qualitative and quantitative bioassay of vitamins from root exudate under asceptic conditions.

The second technique developed here is again a simple design for growing seedlings under controlled conditions in natural soils with the advantage of obtaining root exudates produced *in situ* in soil without injuring the root system (Fig. 1). It consists of a Pyrex container A with distilled water, Pyrex tube B open at both ends, containing a layer of soil C plugged with glass wool at D and kept in position by an annular ring of cotton plug E providing the necessary aeration to the liquid substratum. A layer of acid-washed sand F is placed above the column of soil and this has been found to minimise to a considerable extent contamination from air-borne micro-organisms. By the combined capillary action of the soil and glass wool the moisture level of the soil is automatically maintained at an optimum level throughout the course of the experiment. Root exudates are extracted by subjecting the tube B and the metabolite solution to the perfusion technique of Lees and Quastel,[5] with certain effective modifications on the design developed by Jefferys[6] and the metabolites subsequently evaluated by using modern bioassay and chromatography techniques. In a recent paper a somewhat similar technique has been described[7] but we believe that one of the limitations of that technique is the abnormal condition for plant growth under restricted aerobic and light intensity conditions, whereas in the present technique the plants can be maintained singly under conditions favourable for normal photosynthetic and respiratory activities. This compact unit has the advantage of seldom requiring adjustment, of having no rubber connections and does not seem to be subject to air-borne microbial contamination. Further sampling of the metabolite from container A at intervals is made possible without disturbing plant growth and the unit permits of easy addition of heavy metal metabolites or any other chemicals that are likely to influence root exudates.

Further work on quantitative determinations of exudates of root systems of plants under the influence of antibiotics are now under way and will be reported elsewhere.

We express our deep gratitude to Professor T. S. Sadasivan and Dr. C. V. Subramanian for valuable suggestions and guidance.

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CYTOTAXONOMY OF INDIAN SPECIES OF *CITRULLUS*

THE genus *Citrullus* is represented in India by *C. vulgaris* Schrad. (watermelon) and *C. colocynthis* Schrad. (Colocynth). Besides these two species there is the common vegetable *'Tinda'* which is taxonomically treated as a variety of watermelon, *C. vulgaris* Schrad. var. *fistulosus* Stocks. This variety is indigenous to India.

Crosses were made in all directions between these taxa, but only those between *C. vulgaris* and *C. colocynthis* succeeded. The two species resemble in the vegetative and floral characters but differ in the fruit. In *C. vulgaris* the fruit is big with a thick fleshy rind and contains pink, loose, watery and sweet pulp, while in *C. colocynthis* the fruit is comparatively very small with thin cartilaginous rind and contains white, compact, spongy and bitter pulp. The bitterness is due to the presence of Colocynthin, to which it also owes its medicinal properties.

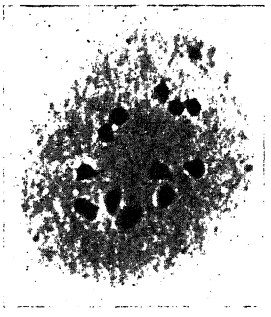


FIG. 1. Twelve bivalents in a pollen mother cell of of *Citrullus vulgaris* var. *fistulosus*, ×1,075.

All the F_1 plants showed marked heterosis and had bitter fruits. The two reciprocal hybrids showed strong matrocliny which is perhaps due to the cytoplasmic genes. The parents and the hybrids possess $2n = 22$ and $n = 11$ which is in conformity with the observations of Whitaker.[3] The chromosomes are very small; hybrids had nearly regular meiosis except for a few univalents at metaphase I and bridges at anaphase I. This resulted in 30-40% pollen and about 35% seed fertility. F_2 was not analysed, but three plants out of 50 showed diplontic sterility.

Incidentally it may be mentioned that there is a possibility of raising better strains of colocynth which ordinarily possesses about 15 fruits per vine each weighing 4-6 oz. The writer noted some plants in the hybrid progeny which combined the useful characters of the two parents, namely, big size and weight (approximately 6 lb.) of watermelon and bitter and spongy pulp of colocynth. On the average these plants bore 6 such fruits.

The crosses involving var. *fistulosus* whether as male or as female parent were always unsuccessful in spite of the repeated attempts. A morphological comparison of this variety with either species indicated many differences involving all the parts of the plant including pollen grains and chromosome number. This variety has $2n = 24$ and consequently 12 bivalents in pollen mother cells (Fig. 1). The size of the chromosomes is much bigger than watermelon and colocynth. Naithani and Das[1] have reported $n = 11$ for this variety which the author was unable to confirm. The present observations agree with those of Pangalo.[2]

The above evidence indicates that biosystematically the three taxa belong to two different cenospecies. To one cenospecies belong *C. vulgaris* and *C. colocynthis* and to the other *C. vulgaris* var. *fistulosus*.

A detailed account including taxonomical aspect will be presented in another paper.

The writer is indebted to Prof. P. N. Mehra, Dr. T. W. Whitaker and Dr. C. F. Andrus for their encouragement and help, and to Mr. R. S. Pathania for taking the microphotograph.

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THE LARVAL SALIVARY GLAND CHROMOSOMES OF *ANOPHELES STEPHENSI* LISTON

THE larval salivary gland chromosomes of the mosquito normally do not present a sufficiently clear and well-defined structure suitable for detailed study. Sutton[1] however found that the salivary chromosomes of *Culex pipiens* showed a structure which would enable maps to be drawn similar to those of *Drosophila*; but in *Aedes ægypti* the presence of certain "weak-spots" rendered it difficult to follow the banding pattern throughout the entire length of the chromosomes. Frizzi[2] discovered that by rearing the larvæ in special culture media the nature of the salivary preparations could be greatly improved. This enabled him to successfully map the salivary chromosomes of *Anopheles maculipennis* variety *atroparvus*.

A study of the salivary chromosomes of *Anopheles stephensi* type form was undertaken and the results obtained are quite encouraging. A laboratory colony of the type form was established in order to provide a continuous and plentiful supply of genetically homogeneous material for the purposes of this investigation. Larvæ for dissection were isolated in small numbers in water corrected for pH and fed

well on yeast. During the final instars suitable quantities of infusorian culture were also added to the rearing medium. The salivary chromosomes in preparations obtained from these larvæ were usually large and showed well-defined banded pattern along their major lengths.



FIG. 1. Metaphase in a brain cell of the larva. From acetic-orcein squash preparation. Approx., × 1,390.

The aceto-carmine squash technique of Painter[3] was employed with certain modifications. The glands dissected out in normal saline were first fixed in a modified Carnoy's fluid for a short period as recommended by Nolte,[4] which lessened the fragmentation of the chromosomes and gave better differential staining. Orcein was found to give a deeper stain to the chromosomes as compared with carmine. Preparations were made permanent according to the method outlined by McClintock.[5] The mitotic chromosomes were studied from simple acetic-orcein squashes of the larval brain.

The salivary gland consists of two lobes, of which the proximal is rounded and the distal, elongated. The proximal lobe consists of about 20 relatively large cells and the distal lobe of about 60 smaller cells. The cells of the proximal lobe possess giant nuclei and a few of these cells disposed about the middle of the lobe are best suited for the detailed study of the salivary chromosomes.

The mitotic metaphase sets of *Anopheles stephensi* type consist of two pairs of V-shaped and a pair of rod-shaped chromosomes (Fig. 1). The rod-chromosomes appear to be connected at one of their ends with heterochromatic dots and constitute the sex-chromosomes. In the salivary gland nuclei the homologues are synapsed together along their entire lengths. Their centromeres are united together to constitute a common chromocentre, from which the individual chromosome arms radiate out. Each V-shaped pair thus shows two arms corresponding to the two arms of the V, whereas the rod-shaped pair shows only a single arm. *Anopheles stephensi* type exhibit five salivary chromosome elements connected by a common

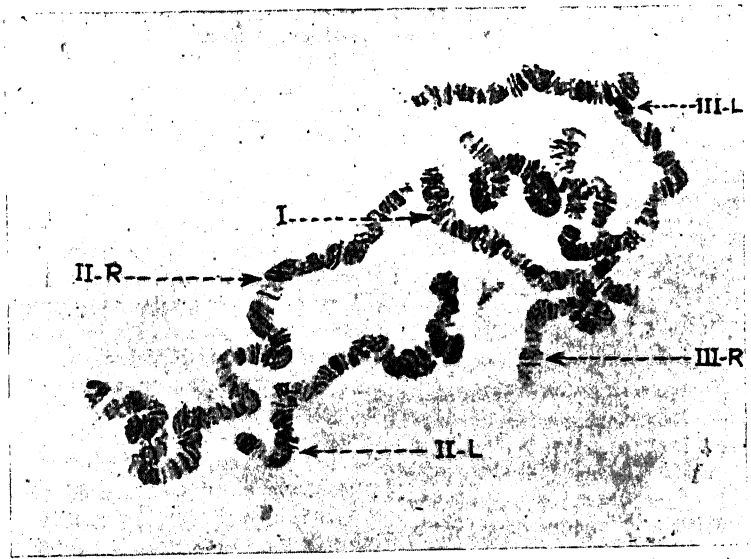


FIG. 2. The larval salivary gland chromosomes. From acetic-orcein squash preparation. Approx., × 500. The roman numerals indicate the chromosome arms mentioned in the text.

chromocentre. The chromocentre however appears to be not a compact structure and becomes easily ruptured on pressure with the result that the five chromosome elements tend to lie separate in well-squashed preparations (Fig. 2).

The sex-chromosome is the shortest element and is designated Chromosome I. The first pair of V-chromosomes constitute Chromosome II and possess two arms, called II-R and II-L respectively. The second pair of V-chromosomes constitute Chromosome III, also showing two arms, respectively known as III-R and III-L.

The individual chromosome arms are identified in a tangle on the basis of certain "landmarks" besides their free ends which are usually characteristic. Chromosome I in addition to being easily recognised by its short length, possesses a distinct "swelling" about its middle. Each of the remaining four chromosome elements is marked by at least two well-defined zones which help to distinguish them easily. The free ends of these chromosome arms are also characteristic excepting that of Chromosome III-R. The serial arrangement of the bands along the length of the individual chromosome arms together with the infra-specific variations in the salivary chromosomes are being worked out.

I wish to thank Dr. K. K. Nayar for guidance, Dr. A. P. Mathew for facilities, and Mr. B. N. Mohan of the Malaria Institute of India, Coonoor, for kindly supplying me with live eggs of *Anopheles stephensi* type form which enabled me to start a colony in this Laboratory.

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BACTERIAL FLORA OF FRESH SHARK*

IN a recent note,[1] Velankar and Sastri described the types of bacteria found in sharks allowed to spoil. Since they did not study the bacterial flora of freshly caught shark, it is not possible to say whether the spoilage flora listed by them is the intrinsic flora or extrinsic ones. The occurrence of the latter in spoiling sharks has been noted by Wood.[2] In this note we are presenting the results of investigation on shark *Carcharius* spp. The huge shark was caught off Tuticorin by R. C. Hooks and was alive. The flora of the skin was plated out on board under aseptic conditions, before the shark was lowered on the deck.

The majority of colonies on the plates were pigmented. Gram negative, non-spore-forming rods were very few, whereas gram positive, spore-forming as well as non-spore-forming rods and cocci were abundant. Six strains resembling *Micrococcus cundidus* were recorded and nine of *Bacillus*, some of the latter having shades of yellow and rose colour. Nine strains of *Corynebacterium* were identified, five of which had yellow chromogens and two pink to red. *Corynebacterium helvolum, C. globiformæ* and *C. simplex* were noted. One strain of pinkish red, non-acid fast gram positive branching rod resembling *Nocardia* was also encountered. The other genera represented are *Achromobacter* (3 strains), *Flavobacterium* (1 strain) and *Vibrio* (1 strain) besides four other *micrococci* also. One non-chromogenic yeast was also present. Our results are thus in agreement with the findings of Wood[2] with regard to the types of bacteria present on shark. We did not however notice any *Pseudomonas* or *Proteus*. It is of further interest to note that Japanese workers[3] also identified *Corynebacterium, Micrococcus, Flavobacterium* and *Achromobacter* on sharks, while Velankar and Sastri did not find any *Corynebacterium* on shark. Wood[2] is of the opinion that *Corynebacterium* also causes spoilage of sharks. The bacterial flora of off-shore sea-water off Tuticorin studied by us, included *Corynebacterium* (pink, yellow, white), *Flavobacterium, Achromobacter, Bacillus, Micrococcus* and *Vibrio* which were also present in sharks. The sea-water also contained a large number of *Pseudomonas* and *Bacterium*. While none of the isolates of Velankar and Sastri produced chromogens, a large number of our cultures were brightly pigmented. In agreement with Wood's[2] findings, we noted motility in *Corynebacterium*, species of which could be fitted into Topping's[4] classification.

As against the presence of indole and H_2S producers in teleosts noted by us,[5] none were found in shark. Starch was hydrolysed by a large number of cultures (23 out of 34) but very few (8 strains) could produce faint acidity in glucose. Similarly, nitrate reducers, were also few (10 cultures). Gelatin liquefiers were abundant (25 strains) while milk-peptonizing cultures were not many (10 numbers). Two cultures produced urease in Christensen's

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medium. It is possible that more of them would prove urease positive in media such as Gibson's, as was noted by us in the case of urea-splitting bacteria from 'Chanks' (unpublished, 1954). Enrichment cultures showed production of ammonia from urea, when dilutions from the surface swab were inoculated, into them. The enrichment of gram-positive types such as *Corynebacterium*, *Bacillus* and *Micrococcus* in shark accord well with the findings of Wood.[2] In view of the findings of Castell[6] that trimethylamine oxide (which is present in large quantities in elasmobranchs[7]) has inhibiting action on gram-positive organisms, it is surprising that there is a rich and varied gram-positive flora on fresh shark as noted by us here and by Wood[2] in Australia.

Further work is in progress. Our thanks are due to Sri. N. V. Choodamani, Assistant Director of Fisheries, Tuticorin, for providing the necessary facilities.

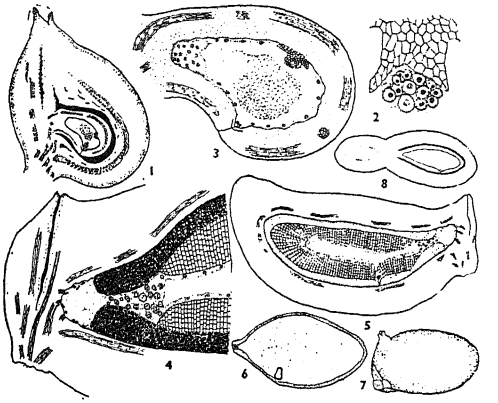
Fisheries Technological Station, Kozhikode, September 26, 1955.

R. VENKATARAMAN.
A. SREENIVASAN.

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ENDOSPERM AND SEED DEVELOPMENT IN *CHRYSALIDOCARPUS LUTESCENS* H. WENDEL.

Chrysalidocarpus lutescens H. Wendel. is a common ornamental palm belonging to the tribe Arecineæ. The fertilisable ovary in this species is laterally compressed and lop-sided and shows a single uniovulate loculus; it is surmounted by three sessile stigmas. The ovule is transverse, hemianatropous, crassinucellate and bitegmic. The micropyle is straight and formed by both the integuments; it is situated a little inner to the anterior end of the ovule and faces the base of the loculus. Its cylindrical massive funicle shows a core of parenchyma surrounded by a ring of 15-20 vascular bundles which traverse in the outer integument nearly to the micropyle. The embryo sac which develops according to the *Normal*-type crushes out all the nucellar cells except the postament which stands opposite to the micropyle. The secondary endosperm nucleus is seen close to the egg apparatus and the three multinucleate persistent haustorial antipodals are located in the postament (Figs. 1, 2). The



FIGS. 1-8. *Chrysalidocarpus lutescens*. Fig. 1. L.S. fertilisable ovary, × 1·5. Fig. 2. Postament from fertilisable ovule with antipodals, × 23. Fig. 3. Early stage in the development of endosperm haustorium, × 13. Fig. 4. Part of the fruit showing endosperm haustorium at a later stage, × 1·2. Fig. 5. L.S. developing fruit, × 0·4. Fig. 6. L. S. mature seed, × 0·2. Fig. 7. Entire fruit, × 0·4. Fig. 8. L.S. 2-lobed fruit, × 0·2.

embryo sac contains dense cytoplasm rich in starch.

Fertilisation is porogamous. The course of pollen tubes is facilitated by the glandular cells that line the top of the loculus. Egg fertilisation is completed after a few endosperm nuclei are formed.

The endosperm is of the nuclear type. Early in development, a chalazal aggregate of endosperm nuclei arises (Fig. 3) and in due course this develops into a massive nuclear haustorium. It expands aggressively crushing out all the overlying parenchymatous and tannin-bearing cells of chalaza and funicle and comes into direct contact with the placental vascular bundles (Fig. 4). The haustorium shows deep staining dense protoplasm rich in starch, and several polyploid nuclei formed by nuclear fusions. Since its cytoplasm runs continuous with the nuclear endosperm surrounding the central vacuole in the main body of the seed, it facilitates rapid transport of food which it receives directly from the placental vascular bundles to the developing embryo (Fig. 5). The endosperm of the haustorium does not become cellular; it appears as a dark mass in the mature seed (Fig. 6).

The endosperm in the main body of the seed becomes cellular by simultaneous cell plate

formation. In the fully developed seed, the endosperm shows two zones: a peripheral one consisting of regular rows of radially elongated cells and a central one of cells irregular in shape and distribution. The cells show thick-pitted walls which store hemicellulose.

After fertilisation the loculus and seed grow transversely making the stigmas look 'basilar' (Fig. 7). Sometimes one or both the vestigial loculi of the ovary grow out into succulent empty protuberances which make the fruit lobed (Fig. 8). Rarely two seeds are seen in a fruit both of which may be fertile or one sterile. As the seed grows more in the region anterior to the micropyle, the embryo comes to lie about midway in the seed. The embryo shows a massive cotyledon which envelops the primary axis leaving a pore for the emergence of the plumule during germination.

The writer wishes to express his grateful thanks to the National Institute of Sciences of India for the award of a senior Fellowship during the tenure of which this study was made.

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Andhra University,
Waltair, *July* 25, 1955.

TWO NEW SPECIES OF THRIPS (*OXYRRHINOTHRIPS*)

THREE species of *Thrips* (*Oxyrrhinothrips*) are reported from India; these are *T.* (*O.*) *Oryzæ*, *T.* (*O.*) *Beharensis* and *T.* (*O.*) *Scolopex*. Two new species of the sub-genus have been collected and are described herein. Their complete description will be published subsequently.

Thrips (*Oxyrrhinothrips*) *Schusteriana* SP. NOV.

Holotype Female (Measurement in microns).—Total length 951. Head length 128, width 126; distance between anterior and posterior ocelli 17, between posteriors 24, length of post-ocellar bristle 24, and longest post-ocular 23. Mouth cone 107. Maxillary palpi (from paratype) basal segment 10, middle 10, apical 13. Prothorax: length 113, width 129, length of posterior angular bristles outer 40, inner 51. Length of tibia: fore 100, hind 144. Length of antenna 214; segments (width in brackets) III 38 (17), IV 33 (16) and V 36 (15).

General Description.—Yellow, eyes black, ocelli with crimson pigmentation. Antennal segment I to IV and basal half of V and VI are lighter, apical half of V and VI and VII entire brownish. Wings uniformly coloured, lighter than body with negligible brown tinge. A row of six bristles running parallel to the hind margin of the compound eyes. One pair of prominent bristles to the inner side of the fore margin of the eyes. Mouth cone just surpassing the posterior margin of posternum. Antennal segments I and II normal, III and IV cylindrical with forked trichomes. Legs uniformly yellow with tarsal tip dark. Wings with 23 bristles to costa, $4+4+1+1+1+1+1=13$ to forevein, and 10 to hindvein.

Host: Sugarcane (leaf-sheath). Collected by Shri N. G. Patel at Baramati (Poona District) on 6-7-1952.

Thrips (*Oxyrrhinothrips*) *bambuscæ* SP. NOV.

Holotype Female (Measurements in microns).—Total length 1248. Head length 87, width 122; distance between anterior and posterior ocelli 9, between posteriors 20, length of post-ocellar 16, and length of longest post-ocular bristle 35. Maxillary palpi; basal 19, middle 12 and apical 16. Length of prothorax 125, width 109; length of posterior angular bristle outer 51, inner 51; length of tibia: fore 110, hind 153. Length of the antenal segments (width in brackets) III 45 (14), IV 42 (12) and V 34 (17). Total length of the antenna 243.

General Description.—Brown, head and 4-6 abdominal segments decidedly darker than the remaining parts; prothorax lighter than pterothorax, all legs light; wings transparent but uniformly light brown except near the base which is lighter. Tip of the mouth cone darkest spot in the insect. Ocelli prominent without pigmentation. Antennal segments I to III, basal half of IV and slight basal of V are lighter, remaining brown, shape normal III and IV being little slender with forked trichomes and VI with long simple sense cone. Wings normal, both fore and hind fringe to the forewing starts before the middle of the border; Costa with 24, forevein, $4+3+1+1+1=10$ and hindvein with 13 setæ.

Host: Bamboo. Collected at Poona by Shri N. G. Patel.

We are indebted to Dr. G. D. Morrisson, N. Scotland College of Agriculture, Aberdeen (U.K.), for having examined the slides, and to Dr. H. Santapau, Botanical Survey of India, Calcutta, for advice in coining the correct names.

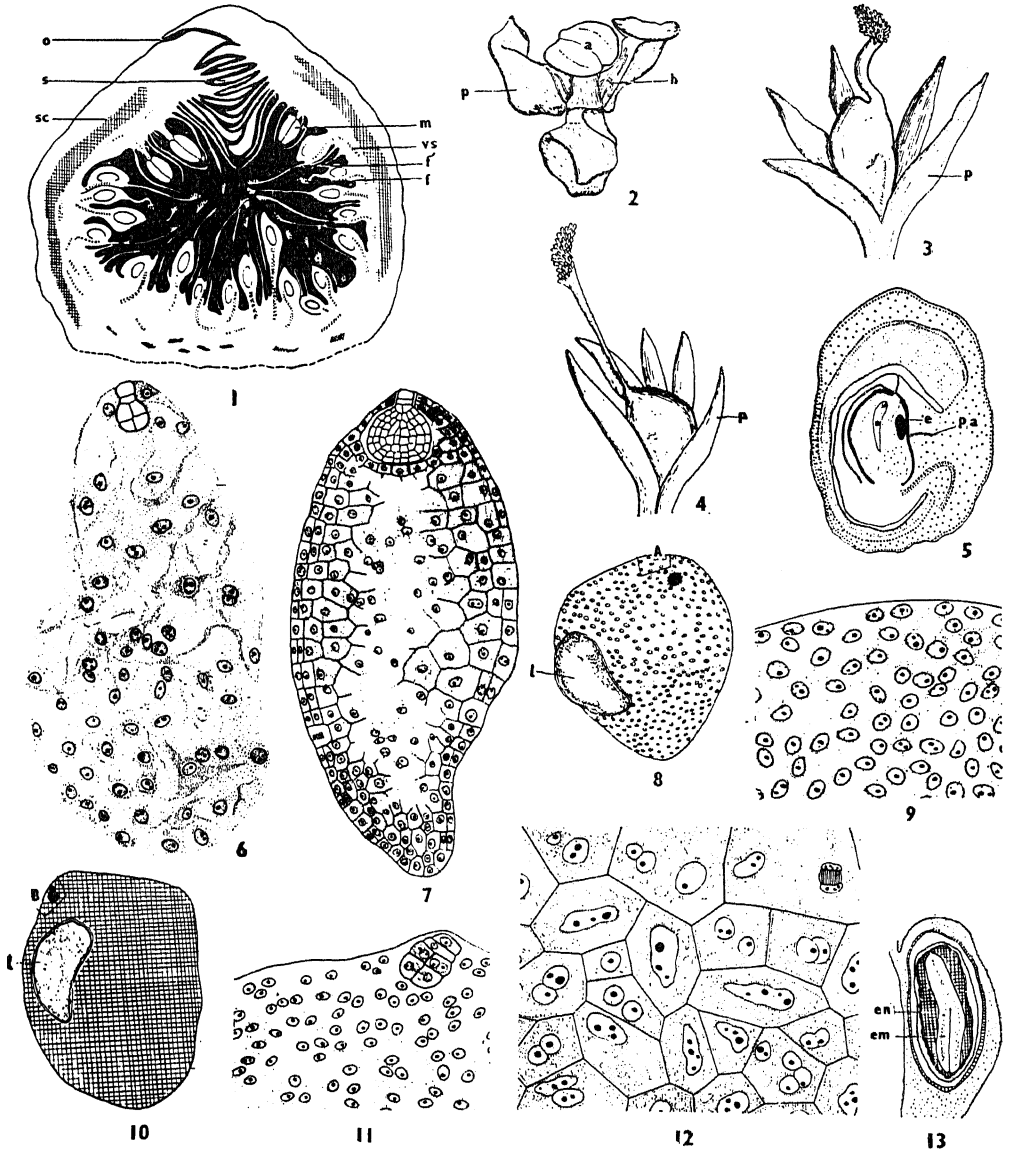
Entomology Laboratory, G. A. PATEL.
College of Agriculture, N. G. PATEL.
Poona, *July* 17, 1955.

A CONTRIBUTION TO THE MORPHOLOGY AND EMBRYOLOGY OF *FICUS RELIGIOSA* LINN.

EMBRYOLOGICAL work on the family Moraceæ, especially the genus *Ficus*, is very meagre. Cunningham[3] studied fertilization in *F. rox-*

burghii and Treub[4] reported the production of parthenogenetic embryos in *F. hirta*. The chief work is that of Condit[1] on *F. carica*.

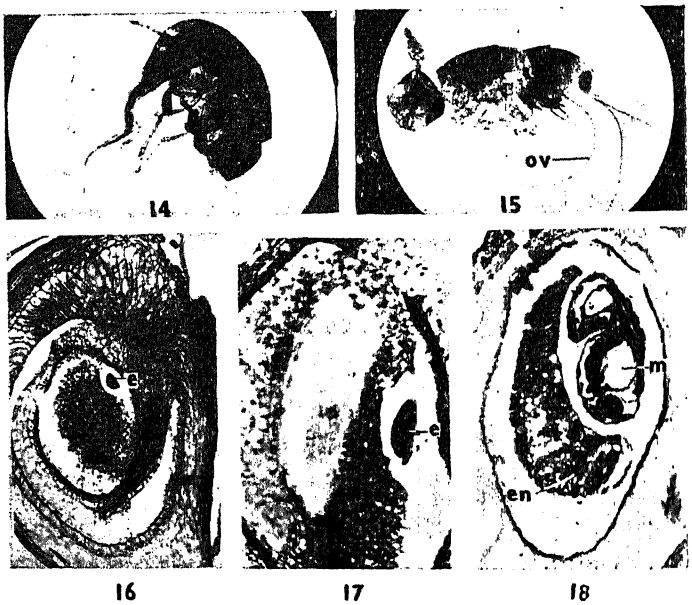
In *F. religiosa*, the cymose inflorescences coalesce to form a fleshy, hollow axis bearing unisexual flowers on the inner side. This syco-



FIGS. 1–13. *a*, anther; *e*, egg; *em*, embryo; *en*, endosperm; *f*, short-styled flower; *f'*, long-styled flower; *h*, hairs; *l*, larva; *m*, male flower; *o*, ostiole; *p*, perianth; *pa*, path of ovipositor; *s*, scales; *sc*, sclereid zone; *vs*, vascular supply. Figs. 6 and 8–12 from dissected whole mounts rest from microtome sections. Fig. 1. L.s. syconium (diagrammatic), × 3. Fig. 2. Male flower, × 7. Figs. 3, 4. Short- and long-styled female flowers, × 7. Fig. 5. L.s. ovary (gall flower) showing the egg of *Blastophaga* lodged between the nucellus and the inner integument, × 30. Fig. 6. Free nuclear endosperm and 6-celled proembryo from long-styled flower, × 267. Fig. 7. L.s. endosperm and embryo, long styled flower; centripetal wall formation has occurred, × 267. Fig. 8. Free nuclear endosperm with proembryo (slightly displaced) and larva (gall flower) (diagrammatic), × 75. Fig. 9. Enlargement of portion marked A in Fig. 8, × 267. Fig. 10. Advanced stage of endosperm and larva (gall flower) (diagrammatic), × 75. Fig. 11. Portion B of Fig. 10 enlarged to show multinucleate condition of endosperm cells, × 267. Fig. 12. Endosperm tissue (gall flower) with polyploid nuclei. × 267. Fig. 13. L.s. seed, long-styled flower, × 30.

nium has an apical ostiole which is more or less closed by overlapping scales (Fig. 1). Twelve to eighteen male flowers are situated adjacent to the ostiole and each shows a single stamen covered over by 3 hooded perianth lobes (Fig. 2). From the base of the anther arise some unicellular hairs. The rest of the inner surface is occupied by short- and long-styled female flowers, each having 5 perianth lobes and a bicarpellary gynæcium (Figs. 3, 4). The average length of the styles in the 2 types of flowers is 0·65 and 2·3 mm. respectively. The short-styled flowers are also known as gall flowers.

enter younger syconia which develop side by side with the ripe ones and their ovules are usually at the mature embryo sac stage. Generally a single insect enters each syconium but sometimes two may enter. During this process they lose their wings which remain sticking to the ostiolar scales. The insect struggles inside the syconium and lays its eggs in the ovaries of the gall flowers. A single egg is deposited in between the nucellus and the inner integument (Figs. 5, 16, 17). Some of the gall flowers may escape oviposition while a few long-styled flowers may be oviposited. Both types of flowers are pollinated at the same time. Finally,



FIGS. 14–18. Photomicrographs. *e*, egg; *en*, endosperm; *m*, maggot; *ov*, ovipositor; Fig. 14. *Blastophaga quadraticeps*, male, × 22. Fig. 15. Same, female, × 20. Fig. 16. L.s. ovary, gall flower (same as Fig. 5), × 65. Fig. 17. Ovule of Fig. 16, from a different serial section, showing healthy embryo sac and the insect egg lodged between the nucellus and the inner integument, × 202. Fig. 18. L.s. immature seed, gall flower, × 73.

A remarkably interesting relationship exists between *Ficus religiosa* and a hymenopterous insect known as *Blastophaga quadraticeps* (Figs. 14, 15). When a mature syconium is ready to fall off from the tree, the wingless males burrow a hole through the ovary walls and escape into the space between the flowers. They fertilize the females (Flander, 1945; *see* Condit[2]) and perish in the syconium. Now the female insects also come out of the ovaries and at this time the scales around the ostiole loosen and allow them an easy exit. While escaping, they incidentally get dusted with pollen. Soon after emerging from a syconium, they the female *Blastophaga* also perishes. The eggs produce the male (Fig. 14) and female (Fig. 15) insects and the life-cycle is repeated. Condit[1] has also given an account of pollination in *F. carica*. In this species the pollinating agent is *B. psenes*.

In both the types of flowers the development of the female gametophyte conforms to the Polygonum type but the following comparisons are noteworthy.

Longo (1909, *see* Condit[1]) observed amitotic divisions in the endosperm of the gall flowers of *F. carica* but Condit[1] does not refer to any such behaviour in this species; nor are we able

Long-styled flowers	Short-styled or gall flowers
1. The endosperm is Nuclear (Fig. 6).	1. The endosperm is Nuclear (Figs. 8, 9).
2. Centripetal wall formation is initiated when about 170 free nuclei have been formed (Fig. 7).	2. Wall formation occurs by cleavage furrowing when the number of free nuclei has increased to several hundred (Figs. 10, 11).
3. Mitotic figures are regular.	3. Mitotic figures are irregular.
4. Nuclear fusion is rare and the cells mostly remain uninucleate (Fig. 7).	4. Nuclear fusion is common and most of the cells are multinucleate (Fig. 12).
5. The nuclei are spherical or oval in shape.	5. Large irregular polyploid masses are formed.
6. A normal embryo is formed and the seed is albuminous (Fig. 13).	6. The proembryo develops only up to the octant stage (Fig. 11), the endosperm is consumed by the growing insect and seed formation fails (Fig. 18).
7. Occasionally, however, *Blastophaga* may develop in approximately 8% flowers.	7. The achenes contain *Blastophaga*, but a normal embryo may develop in approximately 40% flowers.

to confirm it in *F. religiosa*. Condit[1] further reports that in the gall flowers of *F. carica* he noticed only an occasional enlargement of the egg without any subsequent development into an embryo. To quote his own words: "Some egg cells show a slight increase in size, but none show any indication of mitosis of the egg nucleus". He goes on to say that "oviposition by the blastophaga so injures the stylar canal that there cannot be a growth of pollen tubes to the ovule. However, such flowers regularly develop endosperm, a tissue which furnishes the main subsistence of the blastophaga larva. The obvious inference that this endosperm is parthenogenetic is confirmed by the determination of chromosome number". In long-styled flowers, usually triploid endosperm is formed but "a certain amount of parthenogenetic development" occurs in some varieties.

In *F. religiosa* we have noticed germinating pollen grains on the stigmas of the gall as well as the long-styled flowers as was also observed by Condit[1] in *F. carica*. We were unable to follow the pollen tube inside the embryo sac and whether fertilization occurs in the long-styled flowers only or in both types, is under investigation.

We are indebted to Professor P. Maheshwari for advice and comments. Thanks are also due to Dr. J. F. Perkins, Department of Entomology, British Museum (Natural History), London, through whose courtesy identification of the pollinating agent in *F. religiosa* was obtained from Professor G. Grandi, Institute of Entomology, The University, Bologna (Italy).

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University of Delhi, R. N. Konar.
July 26, 1955.

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INFLUENCE OF THE AMPLITUDE OF SUPERIMPOSED AC VOLTAGE ON ALTERNATING CURRENT POLAROGRAPHY

The conventional polarograms obtained with dc potentials applied to the dropping mercury electrode (d.m.e.) in a solution containing electro-active substance(s) are smooth S-shaped curves representing the variation of the current i passing through the cell with the applied potential E[1]. They follow a simple relationship,[1]

$$E = E_{1/2} + k \ln (i_D - i)/i \qquad (1)$$

where i_D is the limiting or diffusion current; $E_{\frac{1}{2}}$, the characteristic half-wave potential of the electro-reducible or oxidisable ion; and k, a constant. It follows from (1) that di/dE is maximum at $E_{\frac{1}{2}}$ where $i = i_D/2$; and that the maximum value of the derivative di/dE is a measure of i_D which, according to Ilkovic equation[2] or its modified forms,[3,4] is proportional to the concentration of the ion undergoing discharge. These features are clearly brought out in the studies of alternating current polarography developed recently by Brayer, Gutman and Hacobian[5]; in this a small ac voltage is super-

imposed on the dc potential applied to the d.m.e. The present communication reports for the first time a few detailed investigations on the influence of the magnitude of the superimposed ac voltage on the *derivative* polarograms (di/dE *vs.* E curves); these results appeared to be of marked practical utility in alternating current polarography (*vide infra*).

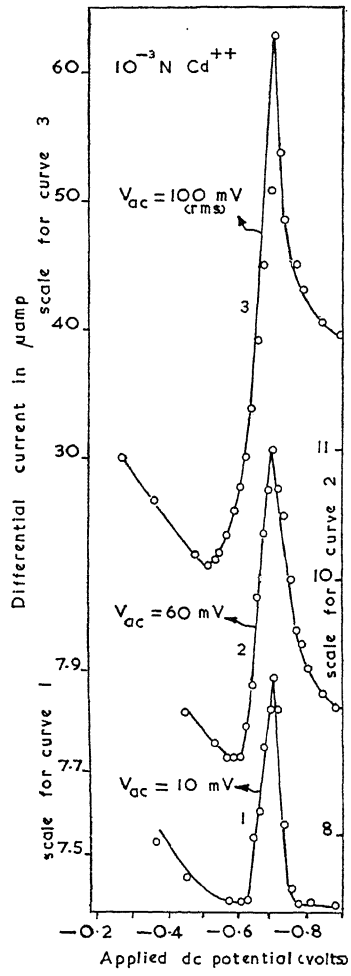


FIG. 1. Derivative polarograms of 0·001 M Cd^{++} in 0·1 N KCl solution at different superimposed ac voltages.

A capillary of the following characteristics was employed: drop time, $t = 4{\cdot}815$ sec., and mass of the drop, $m = 8{\cdot}05$ mg. The dc potentials in the range 0 to 2 volts were obtained by suitable potentiometric arrangement. A Leeds and Northrup audio frequency oscillator gave alternating potentials of the required frequency; in the present studies, ac voltages of 500 cycles/sec. were employed. A known ac voltage in the range 10-100 millivolts was superimposed over the dc potential applied to the d.m.e. which was made negative with respect to the dc potential. The details of the electric circuit employed by the present authors will be given elsewhere; it would suffice here to mention that the alternating current flowing through the system was isolated, amplified and measured by a sensitive current measuring device.

Fig. 1 gives a typical series of results representing the derivative polarograms due to the reversible reduction of Cd^{++} ions in 0·1 N KCl used as supporting electrolyte; these polarograms refer to the electrode process in presence of air. The potential (E_s) corresponding to the peak or summit of the ac polarograms corresponded to − 0·62 volt *vs.* S.C.E. for Cd^{++} in accord with the value reported earlier.[6] Further E_s, characteristic of Cd^{++} was unaffected by a change in the magnitude of the superimposed ac voltage, V_{ac} (*cf.* curves 1, 2 and 3, Fig. 1). The alternating current corresponding to E_s increased progressively with V_{ac}, which is to be expected from a general theoretical consideration of alternating current polarography.[5] A very significant feature of the polarograms (Fig. 1) obtained with different values of V_{ac} is that at low values

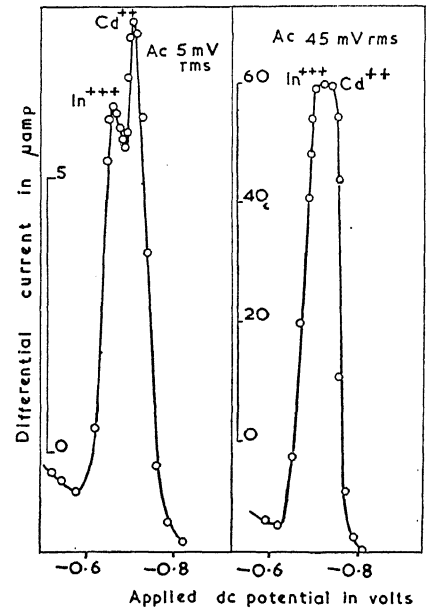


FIG. 2. Separation of derivative polarographic peaks of Cd^{++} and In^{+++} at low superimposed ac voltage (ref. 6).

of V_{ac} the polarograms spread over an appreciably small range of applied dc potentials; thus at $V_{ac} = 10$ millivolts (rms), the wave

spread (at its bottom) over 0·13 volt (curve 1), while at V_{ac} = 100 millivolts (rms) it occurred over 0·37 volt (curve 3, Fig. 1). With low values of superimposed ac voltages, the derivative polarograms are sharp. This feature is of marked importance and elucidates an earlier observation due to Brayer, Gutman and Hacobian[6] regarding the separation of Cd^{++} and In^{+++} in alternating current polarography. In 0·1 N KCl solution, Cd^{+} and In^{++} have $E_{\frac{1}{2}}$ = − 0·61 and − 0·51 volt *vs.* S.C.E. respectively; analysis of a mixture of these two components with dc polarography is not possible. Brayer, Gutman and Hacobian[6] observed two well defined and separate peaks for Cd^{++} and In^{+++} in ac polarography with low superimposed ac voltages, *e.g.*, 5-10 millivolts; however, at large V_{ac} (*e.g.*, 45 millivolts) Cd^{++} and In^{+++} could not be separated (*cf.* Fig. 2). No mechanism for this observation was, however, put forward. The present authors' finding (Fig. 1) clearly points out that the possible analysis of Cd^{++} and In^{+++} with low ac voltages is due to inappreciable spread of the waves.

Chemistry Dept., B. D. Khosla.
University of Delhi, H. C. Gaur.
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ELECTROMETRIC MEASUREMENT OF THE RATE OF OXIDATION OF FERROUS TANNATE BY AERATION IN PRESENCE OF VARIOUS STRONG ACIDS

Karoly Ipolyi[1] determined the acidity of the tannin inks by measuring its electric resistance by means of the Wheatson's bridge, but in the present work the influence of concentration (< 0·01 N) of various strong acids on the rate of oxidation of aqueous ferrous tannate solution by bubbling air was determined electrometrically.

20 ml. of the solution containing 1·82 g. of pure tannic acid (Merck) in 50 ml. of distilled water were introduced in the conductivity vessel, containing a known weight of ferrous sulphate (0·279 g.) and stirred. The air from the aspirators got by displacement method after dehydrating through fused calcium chloride was bubbled through the solution at the rate of 108 bubbles per minute, *i.e.*, 1·0625 litre per hour.

Air supply was disconnected and the oxidation-reduction electrode and the agar-potassium chloride bridge were lowered into the solution at the time of taking reading, after every 10 minutes. After oxidation by air for 2 hours, 5 ml. of 4 N hydrochloric acid were added in order to keep the concentration 5 N and the extent of oxidation was determined by titrating potentiometrically the air-oxidised solution, against standard $KClO_3$ as suggested by Balwant Singh.[2]

The colloidal particles of ferric tannate in suspension obtained by oxidation in acidic solution were found to possess positive charge in the absence, as well as, in the presence of acids, proving that the increase in the time of sedimentation of ferric tannate particles with increase in concentration of acid is due to peptisation and increase in acid concentration. The oxidation in the case of hydrochloric and sulphuric acids is quicker in the beginning and slows down after 45 and 50 minutes respectively. In the case of 0·2 N HCl the oxidation is very slow from beginning to end and for 0·1 N HCl it slows down after 70 minutes. It was found that oxidation goes on decreasing with increase in concentration, but after a certain time, the rate goes on decreasing for all concentrations.

Ferrous-tannate solution in the presence of low concentrations of hydrochloric and sulphuric acids, after oxidation for 2 hours, on titration with 0·1 N potassium chlorate showed conversion to ferric tannate corresponding to the first break at 5-6 ml. of potassium chlorate. Tannic acid, the second oxidation product, corresponds to the second break at 9-10 ml.

It is observed in all cases from oxidation potential graphs that its value increases with concentration of the acid, while R. S. Carter and F. H. Clews[3] observed that oxidation potential of mixtures of ferrous chloride and ferric chloride in concentrated solutions of acid, decreases with the increase in concentration. This was attributed to the removal of ferric ions for formation of complex salts between ferric chloride and hydrochloric acid, but in this case no such complex salt formation with acid at lower concentrations took place.

Forest Res. Inst., C. P. Dhamaney.
Dehra Dun, *April* 20, 1955.

1. Karoly Ipolyi, *Anyagvizs Golok Ko Zlonye*, 1936, **14**, 73.
2. Balwant Singh, *J. Ind. Chem. Soc.*, 1939, 27.
3. Carter, R. S. and Clews, F. S., *J.C.S*, 1924, 1880.

REVIEWS

Polarographic Techniques. By Louis Meites. (Interscience Publishers, Inc.), 1955. Pp. xiii + 317. Price $ 6.00.

Polarography, though barely three decades old, has established itself as a standard method of instrumental analysis in industrial chemical, biochemical and clinical laboratories. Its increasing popularity is not a little due to the rapidity of the estimations combined with the accuracy, which, in most cases, equals and sometimes surpasses that of classical methods. To workers in this field the most authoritative and comprehensive treatise available is the well-known monograph of Kolthoff and Lingane. The volume under review has been planned only as a concise introduction to the theory and practice of polarography and will therefore serve the needs of beginners as a first book on the subject. Its aim is only to supplement and not to supplant Kolthoff's monograph.

The first two chapters which define the scope of polarography and describe the instrumentation provide an easy introduction to the subject. As a knowledge of the theoretical background of polarographic methods is considered essential for a proper mastery of the technique, a lucid exposition of the theoretical aspects is given in two chapters. The chapter on quantitative polarographic analysis, read along with the previous two chapters on half-wave potential data and maxima and their suppression, supply all the necessary information for carrying out polarographic determinations and interpretation of polarograms. Amperometric methods of titration and special techniques like coulometry, millicoulometry and derivative polarography, are dealt with in the last two chapters. A special feature of the book is the number of experiments described with detailed directions at the end of most of the chapters. Appendix A with the title, "Trouble Shooting in Polarographic Circuits", illustrated with numerous defective polarograms and explaining the cause of their defects, will be of special value to beginners for correcting the abnormalities of their curves. Appendix B gives a comprehensive list of data on half-wave potentials and diffusion current constants of inorganic substances, published up to the end of 1954.

One feels that the appearance of a book of this type is a timely reminder of the desirability of including polarographic analysis in the curriculum in practical chemistry at the level of the Master's Degree course.

A. P. MADHAVAN NAIR.

(A) A Manual of Paper Chromatography and Paper Electrophoresis. By R. J. Block, E. L. Durrum and G. Zweig. (Academic Press), 1955. Pp. v + 484. Price $ 8.00.

(B) Introduction to Paper Electrophoresis, and Related Methods. By M. Lederer. (Elsevier Publishing Co., New York), 1955. Pp. xii + 206. Price 37 *sh.* 6 *d.*

Paper chromatography and paper electrophoresis are two analytical tools in the armoury of research chemists and biologists which have been used extensively in recent years for both qualitative and quantitative analyses. A laboratory manual on paper chromatography alone was published by Block and his colleagues in 1952, but recent advances in electrophoretic technique as also the innumerable application of paper chromatography reported in recent literature have induced Block, Durrum and Zweig to come out with a new manual dealing with both paper chromatography and paper electrophoresis.

For a general and introductory treatment of the subject of paper electrophoresis and related methods, Lederer's book can be considered very satisfactory. This book has been written with a view to assist generally the investigators in the fields of analytical, organic, inorganic, radiochemistry and biochemistry. Thus, details have been given in this book under different chapters for the effective separation by the technique of paper electrophoresis, of organic acids, carbohydrates, alkaloids, proteins, nucleic acids, antibiotics, dyes and inorganic compounds. However, the extensive work carried on serum proteins and other clinical applications are only referred to and not discussed in very much detail in this volume. On the other hand, Dr. Durrum has, in his treatment of the subject in Block's manual, laid special emphasis on the separation of protein mixtures, particularly of blood serum. Further, the method of continuous electrophoresis developed chiefly by him has been well described with appropriate illustrations and photographs of actual equipment employed. In the reviewer's opinion, therefore, Dr. Durrum's section on electrophoresis serves

as an extremely useful supplement to Lederer's book on paper electrophoresis.

In the section on paper chromatography, Block and Zweig have succeeded in giving a comprehensive account of the theoretical and practical aspects of the technique. Quantitative methods of estimation of spots in paper chromatograms are also described, particularly with the use of photoelectric densitometers. The individual chapters dealing with paper chromatographic separation of amino acids, sugars, purines, porphyrins and a host of miscellaneous organic compounds, have been exceedingly well written and contain exhaustive references to the literature published during the last few years. It is pleasing to note that the authors have referred to the work carried out on various types of paper chromatography in different institutions in India and published in *Current Science* and other scientific journals in this country, and have even reproduced some tabulated data from recently published literature (p. 300). Further, details of solvent systems, general methods of effective separation of mixtures of biological materials and organic compounds and the R_f values of hundreds of compounds obtained under different experimental conditions have all been incorporated in this manual. Separation of inorganic compounds by means of paper chromatography has also been dealt with in a separate chapter.

In conclusion, it may be said that both these books will undoubtedly prove to be extremely useful to those who wish to know the basic principles and methodology of the twin techniques of paper chromatography and paper electrophoresis, and also to those who wish to have them as ready sources of reference for detailed procedures, and for data required in connection with the effective separation of organic, inorganic and biological materials.

P. S. SARMA.

New Methods in Analytical Chemistry. By Ronald Belcher and Cecil L. Wilson. (Chapman & Hall), 1955. Pp. xii + 287. Price 30 *sh.*

Progress in analytical chemistry has been phenomenal during recent years. Although some good books dealing with instrumental methods such as spectrophotometry, spectrography, and polarography have appeared in the last few years, a text-book dealing with the newer developments of classical analytical methods has been a long-felt need. This book therefore is a valuable supplement to standard text-books as well as to specialised books dealing with instrumental methods. The authors have justifiably claimed to have incorporated considerable non-text-book matter.

The book is divided into seven chapters entitled respectively: Separation by Precipitation; Separation by Extraction; Inorganic Precipitants; Organic Reagents; Indicators; Titrants and Miscellaneous Methods—the titles given being very suggestive. The general principles and the analytical techniques are critically examined at the beginning of each chapter, and these are followed by detailed descriptions of the individual methods. Due stress is laid on the novel technique of precipitation in a homogeneous medium. The details given for the synthesis of the less common reagents are particularly helpful. The authors have themselves tested a large number of the methods described, while the rest of the methods suggested are those recommended by workers of repute.

The authors have accomplished the great task of selection and critical examination of the enormous amount of work done during recent years. The reviewer has no hesitation in recommending this book for study by every one interested in analytical chemistry. The get-up is very good.

K. R. K.

Antibiotics Annual. Edited by Henry Welch and Felix Marti-Ibanex. (Medical Encyclopædia, Inc.; Distributors outside U.S.A.: Interscience Publishers), 1955. Pp. ix + 1154. Price $ 10.00.

This volume documents the proceedings of the Second Annual Symposium on Antibiotics sponsored by the U.S. Department of Health, Education and Welfare, Food and Drug Administration (Division of Antibiotics) and held on October 25-29, 1954, in Washington DC. Those who have gone through the last *Annual* were eagerly waiting for the present volume, but the reviewer at least was not prepared, in spite of his most optimistic estimate, to receive a bulky volume of 1160 pages containing 172 contributions. It looks as if "all antibiotic investigators refuse to rest on their laurels; they are pressing forward in their relentless searches..." The output of scientific work on the antibiotics seem to run parallel to the output of penicillin in U.S.A. which was 29 lb. in the first year of manufacture and 372 tons in 1953. Up till 1946 fairly easily, and up till 1948 with some strain, the reviewer could read all the papers on the antibiotics in the easily accessible journals but today even keeping one's hand on the pulse of this all-pervasive field, even though the medium of the abstracts and reviews, is becoming a very

taxing and heart-rending job. It is in this context that the great value of this *Annual* becomes evident. As pointed out by the editors, "The importance of the contributions made by this meeting to medical science and clinical thinking is reflected by the fact that leading representatives from 36 countries journeyed here to gain the most contemporary findings and opinions as related to antibiotics". The contributions have a bias towards the clinical side and in this volume there is wholesome food for even the most voracious hunter for new ideas and information. The reviewer who has gone through the volume with great eagerness can do nothing more but to underscore the statement of the editors: "No brief summing up can give an adequate idea of the scientific importance of the contributions made in this symposium." The sponsors of the symposium deserve the warmest praise and gratitude from the workers in the field of antibiotics, and we hope that this symposium will be a regular annual or biannual feature—only the venue could be in different countries, East and West. Why not an International Geneva Conference in Antibiotics as a sequel to the recent one in Atomics? As has been very aptly pointed out by President Eisenhover in his message, "Such international co-operation in years ahead may bring ever closer a world of peace and happiness for all mankind".

The present volume is probably a "Best-buy" for $ 10 in U.S.A. but very few in other countries can afford to buy it. The serious question arises: "What then is the function of such a volume?", unless it is retorted that it is far cheaper than making a journey to Washington to know what all happened there.

K. GANAPATHI.

Centrifugal and Rotodynamic Pumps. By H. Addison. (Chapman & Hall), 1955. Pp. x + 530. Price 50 *sh.*

Professor Addison has included in his treatment a wide range of pumps, including not only centrifugal pumps, but all types of impeller pumps where the impeller imparts a tangential acceleration to the liquid and builds up a head. So the treatment covers centrifugal pumps, propeller pumps, fans and blowers, thus including in one group the entire range of the pumping plant which works on the rotodynamic principle.

Chapters are devoted to the design of the impellers, bearings, sealing rings, stuffing boxes and the volute casing. Multi-stage pumps are discussed as well as some special pumps. A chapter is devoted to the testing of pumps, while separate chapters deal with the performance and installation of pumps. The book will therefore be of great help not only to students and technologists, but also to manufacturers interested in the design of pumps, and to others interested in the proper choice, installation and use of pumps.

There is a chapter on allied machinery dealing with electric motors, turbines and engines suitable for driving pumps, with a brief discussion on some types of valves and fittings used in pumping installations. This is naturally very brief and limited, as the purpose of the book is more to discuss the pumping machinery. Some additional information however on piping systems, pipe fittings and frictional drops in pipes and fittings, would have added to the usefulness of the book as a reference book on pumps and pumping systems as a whole.

There is a collection of worked examples at the end of the book which deals with several practical aspects of pumping installations. This is found to be of great interest to the student of hydraulics, as well as to the engineer in the installation and proper use of pumps.

The book, as a whole, will be a welcome addition to a technical library especially in view of the widening field of industrial pumps and pumping installations.

V. S. J.

Further Studies on Cereal Rusts in India, Part II. By K. C. Mehta. (Scientific Monograph No. 18, The Indian Council of Agricultural Research: The Manager of Publications, Delhi), 1952. Pp. vi + 368. Price Rs. 10-2-0 or 16 *sh.*

This monograph is a posthumous publication and summarises the second phase of the Cereal Rust investigations (1930-38) by the late Professor K. C. Mehta. The first monograph (No. 14) dealt with the immense world problem of physiologic races in the cereal rust and the dual problem of alternate hosts and oversummering of rust spores. The monograph under review is the outcome of many years of patient work and includes many maps indicating wind-trajectories and the author has certainly presented masses of data over many parts of undivided India in an attempt to explain the progress of the disease.

Prof. Mehta's conclusions as a result of all his studies are well known and had he been spared to us for some more years he may have canalised all his thoughts and made further

contributions in this growing field of research. However, that was not to be. Nevertheless, the reviewer feels it necessary to recapitulate the major conclusions of Prof. Mehta based on statistical interpretations of his impressive figures covering many tables correlating his spore trap analyses with prevailing meteorological observations. What appears as Dr. Mehta's weightiest argument is that the inoculum is re-introduced on the plains by katabatic winds that bring down the rust inoculum from all hills of about 6,000' altitude and act as foci of infection for each of the three rusts. Statistically, the case of 'relevant winds' in relation to spore showers for black and brown rusts was fairly high and rather low for yellow rust. The most important foci for dissemination of rust inoculum, according to the author, lay in Central Nepal, the Nilgiris and Palni Hills owing to early crops being grown there and from these areas there was an early dissemination to the Indo-Gangetic Plain and Peninsular India.

Prof. Mehta has not only lived up to the exacting demands of such a difficult and complicated long range scientific enquiry but has been a pioneer in India's early scientific achievements. With the great strides being made in the study of aerobiology and evaluation of data on *air spora* in post-war years, much of the aerobiological data collected by somewhat rudimentary equipment then available to science have to be reviewed by contemporary scientific workers in the field. One of Prof. Mehta's major conclusions, *viz.*, that there is little likelihood of the dissemination of rusts to India from across the seas nor is there any evidence of the inoculum coming from adjacent countries except Nepal, needs careful and urgent scrutiny from the breeder's point of view. With our frontiers shortened and with the important geographical position we occupy in Asia it should be possible to use our scheduled flights and our network of air system, both internal and trans-continental, by devising compact spore trap units (by studying aerodynamic principles) in a bid to compile more data on this important and fascinating subject of *air spora*.

I commend this monograph for careful study by mycologists. Today it probably represents nothing more than a working hypothesis and is an introduction, as it were, to this science of air-borne rust dissemination. I only wish that the proof-reading and general get-up of this publication were better than what it is but considering that the data is a scientific diary of a long-range investigation on the subject, chronologically arranged, it will be received well for its usefulness by future aerobiologists in this country and abroad.

T. S. SADASIVAN.

Books Received

New Age Determinations by the Lead Method, Vol. 60. Art. 3. By J. Laurence Kulp, George L. Bate and Bruno J. Geletti. (Annals of the New York Academy of Sciences.) Pp. 509-20. Price $ 0.50.

Hydrocortisone, Its Newer Analogs and Aldosterone as Therapeutic Agents, Vol. 61, Art. 2. (Annals of the New York Academy of Sciences,) Pp. 281-636. Price $ 4.50.

Qualitative Organic Analysis and Scientific Method. By A. McGookin. (Chapman & Hall), 1955. Pp. vii + 155. Price 15 *sh.*

The Quantitative Analysis of Drugs. Second Edition. By D. C. Garratt. (Chapman & Hall), 1955. Pp. xv + 670. Price 70 *sh.*

Symposia of the Society for Experimental Biology, No. 9, Fibrous Proteins and Their Biological Significance. (Cambridge University Press), 1955. Pp. vi + 370. Price 50 *sh.*

Genetics and Cytogenetics in Drosophila funebris. By Ann-Margret Perje. (Stockholm, ALB, Bonniers, Boktryckeri), 1955. Pp. 12.

A Nucleo-Cytoplasmic Anomaly in Drosophila melanogaster *Causing Increased Sensitivity to Anæsthetics.* By Bertil Rasmuson. (Berlingska, Boktryckeriet), 1955. Pp. 148-208.

X-Ray Studies on Antimony (III) Oxide Halo..genides and Some Related Compounds. By Maja Edstrand. (Stockholm, Esselte AB), 1955. Pp. 230-45.

Traffic Forecast and Calculation of Receipts for Motor Road Connecting Sweden and Denmark, No. 92. By Torsten R. Astrom. (Transactions of the Royal Institute of Technology, Stockholm, Sweden), 1955. Pp. 87.

Reflection of Electromagnetic Waves from Thin Metal Strips, No. 91. By Kristen Lindroth. (Transactions of the Royal Institute of Technology, Stockholm, Sweden), 1955. Pp. 62.

Discovery Reports—Euphausiacea of the Benguela Current, Vol. XXVII. By Brian P. Boden. (Cambridge University Press), 1955. Pp. 337-76. Price 12 *sh.* 6 *d.*; *Alepisavroid Fishes.* By N. B. Marshall. Pp. 303-36. Price 12 *sh.* 6 *d.*

Surgery of the Heart and Thoracic Blood Vessels. (The Medical Dept., The British Council, 65, Davis Street, London W. 1), *British Medical Bulletin*, Vol. 11, No. 3 (1955). Pp. 171-242. Price 15 *sh.*

RECENT TRENDS IN APPLIED MATHEMATICS*

THIS volume contains the manuscripts resulting from the invited addresses delivered at the symposium on Applied Mathematics held at the University of Chicago on 29 and 30 April 1954. The value of the papers in the collection has been enhanced by the fact that the manuscripts were drafted after the conference, and consequently included material which was brought out during the interesting discussions. The symposium was sponsored jointly by the American Mathematical Society and the Office of Ordnance Research, U.S. Army, and looking at the names of the participants in the symposium, it is evident that the conference must have stimulated contacts between scientists in the Universities and those in Government Institutions.

There is an amazing variety in the topics dealt with in the book, and this variety comes as an eye-opener to those nurtured in the old classical school of applied mathematics. The first article on Operations Research by P. M. Morse serves to emphasise correctly the nature, the importance, and the techniques of this new field of activity. He has considered three typical problems, *viz.*, the waiting line or queueing theory and the associated Monte Carlo procedure, the linear programming problems, and problems amenable to Neumann's game theory. Finally a new type of problem called the theory of the optimum distribution of effort has been set up, and its intimate connection with applications to military operations, and industry or business activities has been fully explained.

The next two articles by Neyman and Hartley respectively are statistical in character. Neyman has satisfactorily settled a fundamental question relating to modern mathematical statistics by showing that it can be based on the theory of inductive inference which should be considered to belong to the conceptual and not phenomenal, sphere of thought, and that it can be applied in all cases where a stochastic model has been adopted to represent a given class of phenomena. This has been illustrated in an illuminating way by considering the phenomenon of neutral V-particles in nuclear physics, and their decay. The other article by Hartley on recent developments in analysis of variance gives a comprehensive survey of the subject, and presents the most recent developments relating to this valuable statistical technique.

Papers 4-6 relate to computational methods, and numerical analysis. In a brilliant paper on the motivation for working in numerical analysis, John Todd has discussed most of the important and attractive topics that can be handled by this method. Problems in game theory and Monte Carlo processes are shown to be amenable to computational procedures. Recent activity in numerical analysis is illustrated by pointing out biological applications, and applications to combinational analysis, number theory, algebra and topology. Iterative computational methods have been explained by M. R. Hestenes, and shown to be an improvement on the usual methods. The advent of high speed automatic digital computers enables the employment of such methods, and Hestenes has indicated applications to matrix inversion, and matrix eigen-values. Perhaps the finest indication of what has been achieved by numerical computation is given in the article by A. A. Bennet by considering Ordnance problems. He has listed some forty of the most important computing projects undertaken in the Ballistic Research Laboratories of the U.S. Army Ordnance Corps at Aberdeen Proving Ground which operate the best equipped modern high-level computing facilities in the world.

What is more interesting than the wonderful variety of these topics is the awakening of interest, resulting from computational techniques, in many long-neglected fields of pure mathematics. The prophecy of Hermann Weyl that the methods of mathematics considered as formal logic have reached saturation limits, and that new advances can be expected with the help of devilishly fast computing machines, appears to be coming true. Bennet has also indicated very correctly that the problems of a computing laboratory are problems of personnel, not of clerks who can come running at the call of a push-button, but of scientists who can devise the right push-button for slave machines. That these are, after all, slaves is well brought out by the fact that while the fastest modern computing machine would require something over 108 years of continuous errorless operation to invert an ordinary matrix of order 20 by the traditional method of determinants and co-factors, a better suited method can be devised to accomplish this inversion in a few hours.

Papers 4, 8 and 9 relate to what might be called classical applied mathematics. J. E. Mayer has listed two unsolved problems of statistical mechanics, one in which the mathematical equation can be correctly formulated but cannot be solved in a general way although

* *Transactions of Symposia in Applied Mathematics*, Vol. II. Sponsored by The American Mathematical Society and Office of Ordnance Research, U.S. Army, No. 2. (Interscience Pub.), 1955, Pp. 216, Price $5·00.

approximate methods can be used, and another which cannot be set up mathematically because of logical difficulties, although particular cases can be specifically solved. It is shown that the latter case is due to the fact that a simple and useful definition of entropy which can at least lend itself to computational procedures is lacking, and that a fundamental mathematical clarification is therefore needed. In a paper on the simplest rate theory of elasticity, Truesdell has set up a new type of what he calls the theory of the isotropic hypo-elastic body of grade zero, a non-linear field theory which is dynamically admissible for strains and rotations of any magnitude. The theory is a natural extension of the classical one, and appears more satisfactory than even the usual finite strain theory. The notion of stability of mechanical systems has been subjected to a thorough analysis in a paper by J. J. Stoker, and a most interesting example, where stability considerations arise, is given of a new type of synchrotron which would increase the energy of the particles used to bombard atoms by a very large factor. The question of stability which, here, is equivalent to the existence of relatively small deviations from a circular orbit, requires an adequate theoretical analysis since an experimental check cannot be carried out, for the individual particles go around the synchrotron hundreds of thousands of times, and even the most modern high speed digital counters have far too little capacity to carry out numerical computations with accuracy over trajectories which are so long.

The last two papers, are devoted to differential equations and differential operators. In a long paper of over 60 pages, F. J. Burean discusses comprehensively the abstruse notion, due to Hadamard, of the finite part of a divergent integral, and considers Cauchy's problem for the wave equation, and the Euler-Poisson-Darboux equation. Elegant and general solutions are obtained and numerous applications are indicated. The paper closes with a very valuable and comprehensible bibliography. In the last paper of the series, W. Feller discusses the most general class of operators with certain characteristic properties, and shows that these operators can be viewed in a new light as operating in the Banach space of measures where the notion of self-adjointness becomes irrelevant. It is also shown that the introduction of these generalised parameters achieves a considerable simplification and unification of the theory.

The material covered in this symposium is sure to be of the highest significance to all workers in modern applied mathematics and allied fields.

B. S. MADHAVA RAO.

SCIENCE NOTES AND NEWS

Kalinga Prize Award to Dr. August Pi Suner

Dr. August Pi Suner, Spanish Physiologist and Director of the Institute of Experimental Medicine at the University of Caracas, Venezuela, has been awarded the 1955 Kalinga Prize for his work in popularizing science in Spanish-speaking countries.

Born in Barcelona in 1879, Dr. Pi Suner joined the University of Caracas as a Professor of Physiology following a distinguished career in teaching and in research in Spain. In 1922, he received the Achucarro National Prize in Spain for his research in the physiology of the nervous system and, in 1948, he was awarded the Prix Pourat of the Paris Academy of Sciences for his book, *The Vegetative Nervous System.*

In addition to his scientific works, Dr. Pi Suner is the author of an extensive series of books intended to bring science within the grasp of the layman. Among his works which have been translated into English are *The Bridge of Life* and *Classics of Biology.* He has been widely translated into French and above all, he has made an important contribution to the popularization of science in the Spanish-speaking countries.

Synthesis of Benzene by Irradiation of Acetylene

Benzene has been synthesized from acetylene by bombardment with β-rays from tritium at the Laboratories of the General Electric Co., U.S.A. At 26° C., about 72 molecules of acetylene are converted either to benzene or cuprene per 100 e.v.. of radiation energy. As the benzene yield is about 5 molecules per 100 e.v., about 21% of the acetylene consumed goes into the formation of benzene. The fraction of acetylene converted to benzene is found to be independent of acetylene pressure and radiation intensity.

Birbal Sahni Institute of Palaeobotany, Lucknow

The Eighth Scientific Meeting of the Palæobotanical Society will be held at the Institute's premises on 21-22 January 1956. The programme will include lectures, reading of papers and discussions. Palæobotanists from all over India are expected to participate.

Artificial Aurora Borealis

A group of Italian scientists intends to create within the next 2 or 3 years an artificial aurora borealis that will reproduce in temperate climates the phenomenon as it is observed in the Arctic. The aurora will be created by the radio waves transmitted into the ionosphere. This artificial aurora borealis will be an Italian contribution to the International Geophysical Year.

Bibliography on the Infra-Red and Its Applications

A 374-page bibliography on infra-red radiation and its multitude of applications has been made available to the public by the Office of Technical Services, U.S. Department of Commerce. The bibliography includes all references to published literature on the subject from 1935 to 1951. The classification proceeds from infra-red theory and general infra-red-optical properties through the various elements and components of infra-red equipment, infra-red spectroscopy and photography, to its various applications in science, technology, the arts and industry. *Infra-red: A Library of Congress Bibliography*, (PH 111643) may be ordered from OTS, U.S. Department of Commerce, Washington 25, D.C., price $ 3.

Soviet Physics—In English Translation

The American Institute of Physics, 57, E.55 St., New York, will shortly commence publication of *Soviet Physics*—JETP, a periodical translation of research reports appearing in the Russian language, *Journal of Experimental and Theoretical Physics*. The National Science Foundation has granted funds to help finance the first year's operations. The Editor will be Robert T. Beyer of the Department of Physics, Brown University, where the editorial office will be located.

Sleep in Ruminants

During digestion experiments with cattle, C. C. Balch (*Nature*, 1955, 175, 940) observed that the animals never appeared to sleep and always used the same lying position. Throughout the night, periods of lying and resting are interspersed with periods of standing and of rumination. Therefore, if sleep occurs at all in cattle, it must be of the polyphastic type. As a result of his studies, Balch concludes that, under normal conditions of management, healthy adult cattle and sheep, and probably ruminants in general, sleep little, if at all. He suggests that this ruminant peculiarity may be related for upright maintenance of the thorax in proper functioning of the reticulorumen and to the requirement of time and consciousness of rumination.

New Limestone Deposits

A large deposit containing approximately 269 million tons of limestone has been discovered by the Geological Survey of India in the Nandigama Taluk of Krishna District in the Andhra State.

A good deposit of marine limestone of recent age has also been found to occur over an area of about 1½ square miles near Rameshwaram in Ramanathapuram District in the Madras State. The limestone, which is in the nature of an unraised coral reef, ranges in thickness from 3 to 10′. The analyses show that the limestone is of good quality. The deposit is likely to yield more than 5 million tons of limestone suitable for cement manufacture.

Hyla Process of Water Purification

Although the process of treating water with silver salts was originally developed in Switzerland, the principle has been improved by Salem Brosius, Inc., Pittsburgh, Pennsylvania, with successful control of the amount of complex silver salts used with safety. The improved process, known as "Hyla Process' of water purification consists of silver salts deposited on a carrier, such as activated carbon. The water is treated by a short retention of the salts in the system. Experiments at John Hopkins University, Baltimore, Maryland, show that silver salts are effective against bacteria, control slime, and impart residual bactericidal properties to the water. Water so treated has been found to be safe for many applications in the food industry to preserve fruit, vegetables and fish; in dairies, canneries, and beverage plants where equipment must be maintained according to high sanitary requirements; and in the manufacture of ice used to preserve products during transit. The treated water is tasteless, odorless and non-corrosive. —(*U.S. Technical Digest*, D. 4448/2.)

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X-RAYS AND CRYSTALS*

By

Sir C. V. Raman

IT is familiar knowledge that every crystal is a three-dimensionally periodic grouping in space of atomic nuclei and electrons held together by their mutual interactions so as to form a rigid solid. We recognise in each crystal a unit of its structure containing, say, a group of p atoms, this group repeating itself at regular intervals along three directions which are designated as the axes of the structure. The atoms in the crystal may accordingly be regarded as consisting of p sets, all the atoms of a particular set being equivalent to each other and located at regular intervals in a space lattice whose axes are those of the crystal.

2. Diffraction of X-Rays by Crystals

That the geometric picture of crystal architecture briefly indicated above is not just a mathematical hypothesis but a physical reality was first demonstrated by the famous experiment of Laue and his collaborators. When a narrow pencil of X-rays traverses a crystal and is received on a photographic film held behind it, a pattern of spots surrounding the impress of the incident beam appears on the film when developed. It is well recognised that these Laue spots—as they are called—represent monochromatised reflections of the incident X-ray beam by the stratifications of the electron density parallel to the various crystallographic planes in the structure of the crystal. The intensity of each spot is indicative of the magnitude of the corresponding periodic variations of electron density normal to the planes under consideration. The theory of the Laue experiment can be dealt with in a purely classical manner by attributing a certain scattering power to each volume

* Presidential Address to the Indian Academy of Sciences at the Hyderabad Meeting on 27th December, 1955.

element in the electron cloud present in the crystal proportional to its local density. This scattering power derives from the fact that the electrons would be set in motion and oscillate with the same frequency as that of the electro-magnetic field which the incident X-ray beam represents. On this basis, the scattered radiations from all the volume elements would have the same frequency as the incident X-rays, as also specific phase relationships determined by their relative positions. The scattered radiations therefore would be capable of reinforcing each other's effects in certain specific directions determined by the wave-length of the X-rays and the spacing of the stratifications, in accordance with recognised optical principles. Concentrations of intensity accordingly appear in the directions representing a highly restricted selection of wave-lengths from the incident white X-radiation.

3. Atomic Nuclei and X-Ray Diffraction

The foregoing picture is obviously however an over-simplification. It implicitly assumes that the electrons which scatter the X-rays remain firmly bound to the structure of the crystal and that the latter also remains otherwise unaffected by the passage of the X-ray beam. The strength of the binding of the electrons to the atomic nucleus or nuclei closest to them necessarily enters into the picture and would influence the intensity and phase of the scattered radiations to an extent determined by the approach of the frequency of the incident X-radiation to the characteristic X-ray absorption frequencies of the electrons. Indeed, recent X-ray researches have shown that these factors have to be taken into account in the theory of X-ray diffraction by crystals.

The foregoing remarks indicate that considerations somewhat analogous to those which enter into the theory of scattering of light in crystals need to be taken into account also in the theory of X-ray diffraction. When a beam of common light traverses a crystal, its wave-length is very great in comparison with the spacing of the electronic stratifications in the crystal and the latter do not therefore reflect the incident radiation but merely transmit it. On the other hand, it is known that the passage of the light excites vibrations of the atomic nuclei with the result that if the incident light be monochromatic, scattered radiations are observed exhibiting sharply defined shifts of frequency corresponding to the characteristic vibration frequencies of the atomic nuclei about their positions of equilibrium. The appearance of such scattered radiations indicates the existence of a coupling between the forced vibrations of the electrons under the influence of the incident electromagnetic field and the natural or free vibrations of the atomic nuclei about their positions of equilibrium. In the language of the quantum theory of dispersion, the appearance of such frequency shifts is described by the statement that the system composed of the nuclei and electrons does not—following the virtual transitions to higher energy states induced by the incident radiation—return to the same level as previously but shifts to a third level in which the atomic nuclei are in a different energy state of vibration.

In the X-ray experiment, the frequency of the incident radiation is usually much higher than the characteristic frequencies of the electrons. Nevertheless, the ideas of the quantum theory of dispersion continue to be applicable and the question therefore arises whether the incident X-radiations can also excite transitions in the energy state of the atomic nuclei by virtue of their mechanical coupling with the electrons and if so, what would be the observable result of such transitions. We shall now proceed to answer these questions.

4. The Characteristic Vibrations of Crystal Lattices

As remarked earlier, the fundamental feature of crystal architecture is that it is

a repetitive pattern in three-dimensional space of a characteristic unit of the structure containing a finite number of atoms. Each unit of the structure is similar to and similarly situated with respect to the units surrounding it. Hence it follows that in respect of all their physical properties the units of the crystal structure would be similar to each other ; in particular the dynamic behaviour of all the units of the crystal structure would be completely identical. We may put the same situation in slightly different language by saying that every crystal is an assembly of atomic oscillators all of which have identical modes and frequencies of vibration. What these modes and frequencies are is a matter for rigorous mathematical investigation. Such investigations have been carried out and published in recent papers which have appeared in the *Proceedings* of the Indian Academy of Sciences. It emerges that all the atoms in the crystal have $(24p-3)$ modes and frequencies of vibration in common. $(3p-3)$ of these frequencies represent modes in which equivalent atoms in neighbouring cells oscillate with the same amplitudes and in identical phases, while for the remaining $21p$ frequencies, equivalent atoms in adjacent cells oscillate with the same amplitudes but with phases which may be the same or else opposite along one, two or all three axes of the lattice. This picture of the dynamical behaviour of the atoms in a crystal has important consequences for the subject of X-ray diffraction which we shall now proceed to consider.

5. A Classical Analogue

It is useful in the first instance to consider the position from a purely classical standpoint so that the consequences arising therefrom may be taken over into the quantum-mechanical treatment of the problem. We shall restrict ourselves here to a consideration of the $(3p-3)$ modes of vibration of the atomic nuclei in which the vibrations in the different cells of the crystal lattice are identical in all respects. In such a vibration it would follow that the stratifications of electron density in the crystal would not remain in fixed positions but would oscillate to and fro with the frequency equal to that of the mode of vibration concerned. An X-ray beam traversing such stratifications would continue to be reflected in the same direction as in the static case. But in consequence of the periodic motion of the stratifications (assumed to be of small amplitude), the reflected X-ray beam would now consist of three spectral components having frequencies respectively ν, $(\nu+\nu^*)$ and $(\nu-\nu^*)$, ν being the incident X-ray frequency and ν^* that of the oscillation of the lattice. The additional components arising by virtue of the oscillations may be regarded as Doppler shifts of frequency resulting from the movement of the stratifications normal to themselves. The amplitudes of the additional components would be determined by the ratio of the amplitude of the oscillations to the wave-length of the X-rays.

The above classical result translated into the language of quantum mechanics would mean that the incident X-radiation traversing the crystal may excite the characteristic vibrations of the lattice, and if such excitation actually occurs, the beam would be reflected in the same direction as in the absence of such excitation but with diminished frequency. If, on the other hand, the characteristic vibration is already present by reason of thermal agitation, the crystal may be de-excited and the incident X-radiation would then be reflected with increased frequency.

6. Infra-Red Activity and X-Ray Diffraction

It will be seen from the foregoing that the mechanism which can give rise to X-ray reflections of altered frequency is altogether different from the mechanism which results in the scattering of light with frequency shifts in crystals. In the latter case

it is known that a change in the inter-nuclear distances gives rise to a change in the optical polarisability of the elements of the structure and hence also to secondary radiations with altered frequency; the selection rules which determine whether a particular mode of vibration is or is not active in light-scattering are different from those which determine whether or not the same mode is active in infra-red absorption. In the X-ray problem, the shifts of frequency in the X-ray reflections arise from the periodic movements of the stratifications of the electron density associated with the nuclear oscillation. Hence, it may be expected that the excitation and the de-excitation of the lattice vibrations resulting from the passage of X-rays would appear in circumstances analogous to those in which infra-red absorption manifests itself. In other words, X-rays may be expected to excite or de-excite those oscillations of the lattice which are also infra-red active.

7. The Geometry of the X-Ray Reflections

In the foregoing we have assumed that the vibrations in the crystal structure appear in all the cells of the crystal lattice not only with the same frequency but also with identical phases. This is evidently a highly idealised situation, which when it actually exists indicates that the X-ray reflection with altered frequency would appear in precisely the same direction as that of unmodified frequency. The modes and frequencies of the lattice vibrations are determined by the interatomic forces which may be assumed to fall off rapidly in magnitude with increasing interatomic distances. Hence, a change of phase of the oscillations occurring progressively as we pass from cell to cell—provided it be small enough—would involve a relatively small change in the actual frequency of vibration. This would give rise to the possibility of observing X-ray reflections with a change of frequency even in settings of the crystal different from those in which the ordinary or unmodified reflections are observed. Such reflections may be regarded as arising from a forced oscillation of the lattice with slightly altered frequency and with the appropriate phases induced by the incidence of the X-radiation. In such circumstances the intensity of the X-ray reflection of altered frequency may be expected to fall off more or less rapidly as the setting of the crystal is altered from the setting needed for an ordinary reflection.

8. The Influence of Thermal Agitation

As already indicated, it necessarily follows that if X-rays can excite an infra-red active oscillation of the lattice, they can de-excite such an oscillation if it already exists and thereby give rise to an X-ray reflection of increased frequency. The relative intensities of the X-ray reflections with increased and diminished frequencies respectively would be determined by the Boltzmann factor for the particular frequency of the oscillation of the lattice. The reflections of increased and of diminished frequencies would, of course, appear in the same direction, and it is the summation of their intensities that would determine the observed effects. Accordingly, measurements of the variations in intensity of this observable effect with temperature would enable us to estimate the frequency of the vibrations responsible for them.

9. Summary

The quantum theory of dispersion indicates that the infra-red active vibrations of the atoms in a crystal would be excited by the passage of a beam of X-rays through it. Such excitation would result in the incident beam being reflected by the lattice planes of the crystal with appropriately diminished frequency. Such reflections would also be observable but with diminished intensity when the setting of the crystal is moved away from the position in which X-rays of the given wave-length are selectively reflected by the lattice planes in question with unaltered frequency. The effect of thermal agitation is also considered.

THE GENETIC EFFECTS OF ATOMIC BOMB EXPLOSIONS

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I SHOULD perhaps begin by defending myself for writing on this topic. I am not a physicist, still less have I any special knowledge on the physics of the atomic nucleus. Nor have I experimented on the artificial production of mutations, and very little work on this topic has been done under my supervision. On the other hand, twenty years ago Penrose and I were the first to calculate human mutation rates. And as it is feared that atomic bombs have caused, or will cause, increase in these rates, I have at least some claim to knowledge on this matter.

In the first quarter of this century it was found that a great many characters were inherited in accordance with Mendel's laws, though as early as 1902 Correns had discovered some which were not. The inheritance of the Mendelian characters has turned out to be explicable in terms of genes, which are believed to be small sections of chromosome, each responsible for a particular metabolic process, and usually copied very exactly at each cell division. By 1915 it was already known that this copying, or replication, process sometimes went wrong, so that a new gene appeared, and was then copied in its turn. The appearance of a gene of a new type is called mutation.

For example, the human X chromosome, of which women have two in each nucleus, whilst a man has only one, inherited from his mother, includes a small section which is concerned in making a particular globulin in the blood plasma. When this section is altered the globulin is no longer made, and the blood will only coagulate after a day which may last several hours. Persons lacking this globulin are called hæmophilics, and most of them die before puberty.

As a result of natural selection the abnormal gene causing hæmophilia would disappear in a few centuries if it did not constantly arise afresh by mutation. Of the genes responsible for making the anti-hæmophilic globulin, about one in 40,000 mutates in each generation, and a new pedigree of hæmophilia arises..

In 1927, H. J. Muller found that X-rays greatly increase the frequency of mutation of some of the normal genes in the small fly Drosophila. This has since been found to be true in other animals (including mice), many plants, and bacteria. Alpha particles, neutrons, and gamma rays have similar effects. In 1942 Auerbach and Robson proved what had been suspected for some time, that some chemical substances were also mutagenic. In 1955 Fahmy and Fahmy proved that one such substance caused genes in Drosophila to mutate which had never been known to mutate spontaneously or under the influence of X-rays.

The question then arises: "If a large number of human beings are exposed to abnormal amounts of high frequency radiation, what effects may be expected in their descendants?" The first point to be made is that everyone is exposed to a certain amount of high frequency radiation, especially from cosmic rays, and from the radioactive isotope of potassium. The mean dose per generation is about 3 roentgens, but it may be as high as 5 or 6 in high countries like Tibet where cosmic radiation is more intense, and in igneous areas like some of Southern India where the soil contains appreciable amounts of radioactive elements.

In *Drosophila melanogaster* it is fairly easy to measure the frequency of lethal mutations, that is to say, mutations which cause so great a change as to kill the flies in the egg or larval stage. Most such mutations are recessive. That is to say the abnormal gene is harmless or nearly so, provided the animal has received a normal gene from one parent. Occasionally we understand why this should be so. Thus normal human beings can oxidise phenylalanine to tyrosine with a very specific enzyme found in their liver cells. This enzyme is only formed if a normal gene is present in a cell nucleus. If neither parent contributes such a gene, the enzyme is not formed. The blood and cerebrospinal fluid contain large amounts of phenylalanine and oxidation products such as phenylpyruvic and phenyl-lactic acids, which are also excreted in the urine. The head is usually rather small, and a child unable to oxidise phenylalanine is always mentally backward and generally an idiot, dying fairly young. The abnormal gene, which does not produce phenylalanine oxidase, is handed down (by copying) for many generations in healthy people till two such people (heterozygotes for the gene) marry. Such marriages are particularly common between cousins, who may both have received the abnormal gene from a common ancestor.

Some recessive genes formed by mutation disappear by chance. Others spread by chance. But on an average, two such genes are only lost from the population as the result of a premature death, or a sterility.

Probably over 2% of all children born die before puberty as the result of such recessive genes, and many more die before birth. Now if we knew what fraction of human mutations is due to radiation we could calculate the effect of a given addition to the amount received. We do not know this. In *Drosophila melanogaster* most mutations are not due to radiation. But a human generation is about 500 times as long as a Drosophila generation. And a human nucleus contains about 30 times as much desoxyribonucleic acid (of which genes are probably composed) as a Drosophila nucleus. So the number of mutations produced by radiation in a human generation may be expected to be about 15,000 times as great as in the same number of Drosophilæ. It is therefore quite possible that most human mutations are due to radiation.

The amount of radiation needed to produce a lethal mutation in a *Drosophila melanogaster* is about 10,000 roentgens. More accurately about 1% of eggs or spermatozoa of flies exposed to 100 r. will carry a lethal mutant. About 4 times this number will carry a sublethal mutant causing serious abnormality. If man is 30 times as sensitive, the 3 roentgens received per generation should produce a lethal gene in about 1% of spermatozoa or ova and a sublethal in about 4%. Between them they would account for something like half or a third of the lethal and sublethal genes in human populations.

If we take the lower figure of one-third, this would mean that if the human race were permanently exposed to 10 r. per generation, the deaths and illnesses due to genetic causes would be about doubled. If, as I suppose, some kinds of mutation are not mainly due to radiation, some kinds of illness would be increased more than others.

Sir John Cockroft, in a recent article in *Nature*,[1] estimated the average increase in high frequency radiation at ground level due to the explosion of atomic bombs. Bombs such as were exploded over Japan had a negligible effect on the radioactivity at ground level beyond a few kilometres from the site of the explosion. Thermonuclear or "hydrogen" bombs contaminate the whole planet.

Cockroft states that enough radioactive elements have fallen and will fall on the surface of England to give "completely unprotected persons" a mean extra dose of about 0·03 r. He adds that as most people spend a good deal of time indoors, and brick houses give considerable protection, this dose is probably reduced to about a tenth on an average. This is very reassuring to British readers. But he did not add that most of the people in India spend a great deal of time out of doors, and their houses have very thin walls which give no serious protection against gamma radiation from outside.

It follows that if radioactive substances are spread fairly evenly all over the world, most of the harmful genetic effects will occur in countries like India, Pakistan, Indonesia, Tropical Africa and Brazil, where conditions are similar. I am sure that Sir John regrets this, but some persons associated with him may not do so. Thus Sir Ernest Rock Carling, official representative of the British Government at the recent Geneva Conference at which Dr. Bhabha presided, said, "In a world contemplating a future in which the expansion of its population may outrange its food supply, it is conceivable that diminished fertility and shortening of the life-span might not altogether be deplored". He might deplore these consequences even less if they were largely concentrated in tropical countries.

It is very hard to estimate the probable killing effect on Indians. But if we assume that about 15 crores of future Indian parents have been erposed to ·03 r., this gives a total dose of $4{\cdot}5 \times 10^6$ r. which might cause 15,000 lethal mutations and 30,000 or 40,000 sublethal. Most of them are recessive, so that we should expect one death for every two mutations if the population remains about its present level, but more if it increases, perhaps 30,000 deaths in all. These extra deaths will be spread over many thousand years, though the maximum incidence will probably occur in the next century.

The British Government is probably going to explode a hydrogen bomb in the next year or so. The Americans are reported to be about to explode two. The Soviet Union will probably follow their example. Although its government wishes to prohibit atomic bombs, it would presumably not accept the arguments of this paper, which are based on "Mendel-Morganism". These explosions, if they occur, may produce about as much more radioactivity as Sir John Cockcroft allowed for. Sonnenblick[2] estimates a mean dose for the human race of 0·2 to 0·3 r. I have based my calculations on a much lower figure to avoid alarmism.

India is the most important state in a position to protest against all such projects, and, as I have shown, it has special reasons for doing so. The Indian Government might also initiate experiments designed to estimate the probable effects. The figures which I have given are conjectural. They may be too high by a factor of ten or even more. They may also be too low. The experiments on mice whose results have been so far published in the U.S.A. were not so designed as to estimate the risk. They showed that some genes in mice were much more easily caused to mutate than genes in Drosophila, but they gave no estimate of the number of genes at risk. And one cannot safely argue from mice to men. But the risk to mice could be determined experimentally, and the effects of X-rays or gamma rays on human and mouse tissue cultures compared. The research could be done in India. I have worked out a scheme for the research on mice, but wish to discuss it with colleagues before publication.

I am quite aware that it is frequently stated that so many people die already from the effects of mutation that an increase by an extra few per cent. does not matter. Such an opinion does not coincide with my own ethical views. I venture to hope that these views are shared in India.

1. *Nature*, 1955, **175**, 873.
2. *Genetics*, 1955, **40**, 597.

CONFLICT *VS.* CO-OPERATION AS FACTORS IN EVOLUTION*

A SEGMENT of Acharya J. C. Bose's own philosophy of the "Unity of Life" forms the subject-matter of this Memorial Lecture. According to Bose, it is a misunderstanding of the Laws of Nature to regard conflict as the only factor in evolution; far more potent than competition is mutual aid and co-operation in the scheme of life. He had also pointed out that there must be unity of all human efforts and that in the realm of the mind there can be no boundaries and no separations. For, the evolutionary process has been active not only in morphological differentiation, that is, in the development of new forms, but also in physiological differentiation, that is, in the development of special mechanisms for performance of various vital functions. Thus every organ of a living being is an instrument subserving a particular function for the advantage of the organism.

The above views expressed by Bose as early as 1927 are not only very significant and important but prophetic when judged by the present-day urge for peace among the nations of the world through the adoption of the principles of *Panch Shila*. Modern development in the biological sciences would also tend to refute the Darwinian principles of evolution through random variations, competition, struggle for existence, natural selection and survival of the fittest, and lend support to evolution through the adjustment of organisms to the physicial and biological factors in their respective environments. Thus the principle of coexistence, in spite of varied conditions of life, is biologically sound for all living organisms, including the human race. Biological principles would only appear to lend support to the philosophy of Acharya Bose that "far more potent than competition is mutual aid and co-operation in the scheme of life".

* Abstract of the Seventeenth Acharya Jagadish Chandra Bose Memorial Lecture by Sunder Lal Hora.

INDIAN SCIENCE CONGRESS, FORTY-THIRD SESSION, AGRA

THE Forty-Third Session of the Indian Science Congress Association will be held at Agra during the week 2-8, January 1956, under the presidentship of Dr. M. S. Krishnan. The session will be inaugurated by the Prime Minister, Shri Jawaharlal Nehru.

Besides scientists from all parts of India, the following distinguished visitors from abroad are expected to attend the Congress: Prof. Martin Eichler and Prof. C. L. Siegel (W. Germany), Prof. B. A. Houssay (Argentina), Prof. M. H. Stone, Dr. D. W. Bronk and Dr. Robert Oppenheimer (U.S.A.) and Dr. J. H. Burn (U.K.).

A number of symposia have been arranged and an exhibition of instruments, apparatus and equipment will also be organised during the session.

INDO-PACIFIC FISHERIES COUNCIL

THE Sixth Session of the Indo-Pacific Fisheries Council (which is an Inter-Governmental organization of sixteen countries of the Indo-Pacific area) was held at Tokyo (Japan) from 30th September to 14th October 1955. The session was attended by delegations from all the member countries of the Council, *viz.*, Australia, Burma, Ceylon, France, India, Japan, Korea, Netherlands, Pakistan, Philippines, Thailand, U.K., U.S.A., and Viet Nam. Observers also participated on behalf of the UNESCO, South Pacific Commission, the World Meteorological Organisation, and International Commission for Scientific Exploration of the Mediterranean.

During the session, it was decided to observe Indo-Pacific Fisheries Years at regular intervals when attempts will be made for simultaneous collection of statistics relating to fisheries and other ancillary biological factors by the different countries in the Indo-Pacific region. The first Indo-Pacific Fisheries Year is proposed to be observed in 1957-58 to coincide with the International Geophysical Year. Various other proposals to increase the efficiency of the Council work during and between the sessions were discussed and formulated. Co-operative plans for research in India, Burma and Pakistan on the Hilsa fisheries were adopted at the session, as also steps taken to initiate such co-operative research on the mackerel (*Rastrelliger*) fisheries which is one of the most important marine fisheries of South and South-East Asia. A Symposium on Prawn Fisheries held along with the session and at which many specialists participated highlighted the great value of this sea fishery resource to the Indo-Pacific area. It was decided to hold an International Symposium on Fish Culture in Rice Fields during the seventh session of the Council.

India was represented on the Council by Dr. N. K. Panikkar, who also participated at the conclusion of the session in meetings convened by the UNESCO at Tokyo on Marine Sciences. Dr. Panikkar (India) was unanimously elected as Chairman and Mr. D. J. Rochford (Australia) as Vice-Chairman of the Council for the ensuing period. The next session of the Council will be held at Bandung in Indonesia in 1957 at the kind invitation of the Indonesian Government. A special meeting of specialists to draw up a co-operative programme on *Rastrelliger* is proposed to be held in Malaya in 1956.

NATIONAL MERIT SCHOLARSHIP PROGRAM, U.S.A.*

FORMATION of the National Merit Scholarship Corporation, Evanston, Ill., was announced on 6 September by its President, John M. Stalnaker. The Corporation is an independent, non-profit organization whose purpose is to devise and administer a nation-wide system of scholarships for higher education. The Ford Foundation and the Carnegie Corporation of New York have undertaken to finance the activity by providing grants totalling $.25 million for its administrative expenses. The Ford Foundation has also appropriated a $ 10 million scholarship fund, payable at the rate of $ 1 million a year for 10 years, and is prepared to finance additional scholarships up to a total of $ 8 million. All Secondary Schools, public and private, are entitled to participate in the programme.

The major underlying purposes of these grants are twofold: to find the country's most talented young people and make a college education available to them regardless of their financial situation; and to make it easy for business enterprises to contribute effectively to the support of higher education. A further purpose is to provide, in one organization, a single programme that will reduce wasteful duplication of operation and expense and will, at the same time, protect fully the natural interests and purposes of the donors. The flexibility of the present programme provides this protection.

Beginning this fall, the more than 24,000 Secondary Schools of the nation will be invited to participate annually in the National Merit Schoalrship Programme. The selection will be made in a series of stages and finally, the highest for each state to the extent of five times the number of scholarships to be awarded, will be requested to supply further information with regard to school records, recommendations, and biographical information. Using all of this background material, the selection of the winners will be made.

It may be worthwhile to initiate a similar programme in our country for the recruitment of the best scientific talent.

* *Science*, 1955, **122**, 508.

A NEW METHOD FOR THE ESTIMATION OF NITROGEN IN CELLULOSE NITRATE

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THE two methods commonly employed for the estimation of nitrogen in cellulose nitrate are: (*i*) The Lunge Nitrometer method [1] and (*ii*) The alkaline peroxide digestion or the modified De Varda's method.[2] In the former method the nitrate groups are reduced to nitric oxide (NO) by the Hg-H_2SO_4 system which is then measured. In the latter method the cellulose nitrate is dissolved by digestion with alkaline hydrogen peroxide followed by reduction with De Varda's alloy. The ammonia formed is estimated as usual. The De Varda's method has been used by Davidson,[3] and Kenyon and co-workers.[4] However, it is well known that during the saponification of cellulose nitrate by alkali the nitrogen is partly converted into nitrite,[5] cyanide,[6] nitrogen[7] and ammonia.[8] Therefore it is likely that some loss of nitrogen may occur during the digestion in the second method even though the losses may be minimised on account of the presence of the hydrogen peroxide. With a view to overcome this difficulty, the method has been modified as follows: The sample is dissolved in concentrated sulphuric acid. This solution is slowly added to a strong solution of caustic soda in the distillation flask of the ammonia estimation apparatus. The mixture is then treated with De Varda's alloy and the ammonia formed estimated as usual. A number of samples of cellulose nitrate have been prepared and analysed for their nitrogen content by (*i*) Lunge's method, (*ii*) the modified De Varda's method, and (*iii*) the new method.

EXPERIMENTAL

Preparation of Cellulose Nitrate.—Carefully purified cotton yarn (2 g.) cut to small bits ($< 1/16''$) is immersed[9] in a mixture (100 ml.) obtained by mixing 1 vol. nitric acid (sp. gr. = 1·52) and 2 vol. sulphuric acid (sp. gr. = 1·84) maintained at 0° C. At the end of the requisite period the cellulose nitrate is freed from the spent acid by filtration through a sintered glass filter. The nitrated sample is then plunged into a large volume of ice-cold water. The product is washed free from acid by repeated changes of water. The samples are dried by exposure to air and stored carefully.

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ANALYSIS OF CELLULOSE NITRATE SAMPLES

1. *Lunge's Nitrometer Method.*—A Lunge Nitrometer calibrated to 50 ml. in 1/10 ml. is used. The nitrometer is filled with clean mercury. About 100 mg. of the sample is accurately weighed out into the cup of the nitrometer. It is then dissolved by the addition of 10 ml. of pure nitrogen-free concentrated sulphuric acid. The solution is then carefully drawn into the nitrometer without drawing in any air. The cup is then rinsed with two or three 2 ml. portions of pure sulphuric acid. Each lot of the acid is drawn into the nitrometer before the next lot is added. The apparatus is then vigorously shaken so that the mercury and the acid are mixed thoroughly. After allowing the apparatus to come to room temperature the pressure of the gas in the nitrometer is brought to atmospheric by raising or lowering the levelling tube. After the volume is measured the nitrometer is vigorously shaken again and the volume of gas at room temperature and pressure measured. Usually there is no change in volume.

2. *Modified De Varda's Method.*—100 mg. of the sample is accurately weighed into a Kjeldahl flask. Then 2-3 ml. of ethyl alcohol, 20 ml. ammonia-free distilled water, 5 ml. 25-30% H_2O_2 and 4 ml. of 40% caustic soda solution are added. The flask is then heated on a steam-bath till the sample is dissolved. It has been noticed during the course of the present investigation that lower the nitrogen content of the sample the longer is the time required for digestion. The excess of hydrogen peroxide is destroyed by heating on a steam-bath till effervescence ceases. The flask is then cooled to room temperature and 15 ml. of 40% caustic soda solution and 100 ml. of ammonia-free distilled-water added. 1·5 g. (60 mesh) De Varda's alloy is then added to the mixture and the flask immediately connected to the ammonia distillation train. When the hydrogen evolution has ceased (30 min.) the contents are boiled and the ammonia evolved is estimated by absorption in standard hydrochloric acid (50 ml. of 0·04 N) containing 10 drops of the mixed indicator[10] and backtitrating the excess acid with carbonate-free 0·04 N sodium hydroxide from an automatic burette fitted with soda line traps. A blank is carried out with the reagents used. The mixed indicator[10] is prepared by mixing

2 ml. of aqueous methylene blue solution (1%) with 100 ml. of 0·04% solution of methyl red in 50% alcohol. The change at the end point is from pink through grey to green and is quite sharp. A blank is also carried out with the reagents used.

3. *The Proposed Method.*—100 mg. of the sample is accurately weighed and dissolved in 5 ml. of pure nitrogen-free sulphuric acid. The solution is neutralised by slow addition through a dropping funnel to a mixture of 30 ml. of 1:1 caustic soda solution and 100 ml. of ammonia-free distilled-water in the distillation flask which is connected to the ammonia distillation train. The funnel is then washed down with two or three 2 ml. portions of pure sulphuric acid, two 50 ml. portions of ammonia-free distilled-water and 5 ml. of ANALAR ethyl alcohol. The solution in the flask is pale yellow or practically colourless. De Varda's alloy (1·5 g., 60 mesh) is introduced into the distillation flask through a side tube which is immediately stoppered. The evolution of hydrogen is complete in about half-an-hour. The solution is then raised to boil and the distillation continued for half-an-hour. All the ammonia distils were over within this time. The ammonia that distils over is estimated as described previously. A blank is also carried out with the reagents used.

The results are given in Table I. From the results it can be seen that the proposed method gives values in close agreement with those obtained by the Lunge's method. It is also evident that the modified De Varda's or the alkaline peroxide digestion method gives consistently lower values.

TABLE I

Estimation of nitrogen in cellulose nitrate. The numbers given are the percentage of N, found as an average of three measurements in each case

Sample number	Lunge's method	Modified De Varda's method	Proposed method
1	8·71	8·23	8·76
2	10·5	9·85	10·46
3	11·23	10·16	11·2
4	12·46	11·56	12·43
5	12·86	12·43	12·93

1. *The Methods of Cellulose Chemistry*, C. Dorée, 1947 edn., Chapman and Hall, p. 244.
2. —, *Ibid.*, pp. 247–48.
3. G. F. Davidson, *J. Text Inst.*, 1938, **29**, 198T.
4. W. O. Kenyon and Co-workers, *J. Amer. Chem. Soc.*, 1947, **69**, 342.
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6. W. Will, *Ber.*, 1891, **24**, 400.
7. C Hausserman, *Chem Ztg.*, 1905, **29**, 421.
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ATOMIC WASTE PRODUCTS

THE probable increase in the number of atomic power plants within the next few years poses a serious problem to the industry. That is the disposal of the radioactive materials which are produced in the reactors.

One proposed method is to enclose it in large concrete blocks and drop it into the ooze at the bottom of the deepest part of the ocean. By the time the concrete is worn away, thousands of years would elapse and the radioactivity would have decreased to almost zero. But some experts feel that there may be strong currents in the sea at great depths, so the concrete would be worn away more rapidly and the radioactivity would be released; it would thus find its way into plants and fish and become dangerous as human food. On the other hand, even if this happened, the radioactivity would concentrate only in the bones and scales of the fish, which are not used as food.

Another suggested method of disposal is to bury these materials under heavy concrete in deep abandoned mines or even in deep natural caves. This would be safe enough except that explorers and archæologists centuries into the future might unsuspectingly encounter their rays. The strangest suggestion was made by an American professor who proposed that these materials should be loaded into a space rocket and sent permanently far from the earth, cruising through the remote regions of the universe like a lost star!

It was agreed at the United Nations Conference on the Peaceful Uses of Atomic Energy in Geneva that the problem *must* be solved, and that meanwhile scientists and governments should make certain, probably by international action, that proper precautions are always taken for the disposal of radioactive waste.

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SPECIFIC HEAT AND ENTROPY OF LIQUID He^3

The specific heat of liquid He^3 has been measured by Roberts and Sydriak[1] in the temperature range 0·54° K to 1·7° K. Their results are in general agreement with the data of other workers.[2,3] The purpose of this note is to suggest an equation for the specific heat-temperature curve which fits with the experimental values,* and to obtain from it an equation for the entropy of liquid He^3 using the thermodynamic relation $S = \int \frac{C}{T}\, dT$.

Assuming the atoms of He^3 in the liquid to behave as an ideal degenerate Fermi-Dirac gas, in which phonon excitations are possible, the specific heat C can be expressed as a sum of a linear term and a cubic term in temperature T, *i.e.*, as

$$C = A + BT + CT^3 \text{ cal deg}^{-1} \text{ mole}^{-1} \qquad (1)$$

where the constant A appears to yield the observed value of C at any particular temperature. For best fit the constants are found to be $A = 0{\cdot}670$, $B = 0{\cdot}288$, and $C = 0{\cdot}078$. In Table I are collected the observed values of

* During the publication of this note the paper of Roberts and Sydoriak (*Phys. Rev.*, 1955) 1672, **98,** has appeared in which the suggested equation has been used with different values of constants.

specific heat by Roberts and Sydoriak[1] and the values calculated from (1).

TABLE I

Specific heat of liquid He^3 in cal deg^{-1} $mole^{-1}$

T° K	Ref. 1	Calculated (1)
0·540	0·83	0·838
0·629	0·89	0·871
0·748	0·92	0·918
0·804	0·92	0·942
0·872	0·98	0·993
1·069	0·06	1·073
1·157	1·12	1·124
1·251	1·22	1·183
1·256	1·19	1·200
1·364	1·25	1·261
1·453	1·35	1·328
1·528	1·44	1·389
1·609	1·46	1·458
1·695	1·54	1·538

The entropy of liquid He^3 when derived from (1) reads:

$$S = A\ ln\ T + BT + C/3\ T^3, \text{ for } T \geqslant 0{\cdot}5^\circ K \quad (2)$$

From the above equation the correct value of S at any particular temperature is obtained by setting $S = 2{\cdot}09$ cal deg^{-1} $mole^{-1}$ at 1° K, *i.e.*, the value calculated by Weinstock, Abraham and Osborne[4] from the vapour pressure data. Then (2) becomes

$$S = 1{\cdot}776 + 0{\cdot}670\ ln\ T + 0{\cdot}288\ T + 0{\cdot}026\ T^3 \quad cal^{-1}\ deg\ mole^{-1} \quad (3)$$

As shown in Table II, the calculated values of S from (3) are in close agreement with the results of Weinstock, Abraham and Osborne[4] over a large range of temperature.

TABLE II

Entropy of liquid He^3 in cal deg^{-1} $mole^{-1}$

T° K	Ref. 4	Calculated (3)
0·5	..	1·459
1·0	2·09 ± ·14	2·090
1·5	2·50 ± ·17	2·567
2·0	3·00 ± ·22	3·040
2·5	3·66 ± ·29	3·548

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A NOTE ON THE BOILING POINTS OF REGULAR SOLUTIONS

GUGGENHEIM[1] has shown that the thermodynamic properties of binary liquid mixtures, which deviate only slightly from ideality, can be determined from the quasi-crystalline model proposed by him. The application of this model to the evaluation of the interchange energy requires very accurate experimental observations on the thermodynamic properties of binary mixtures of liquids which very nearly satisfy the conditions for regular solutions.

The partial vapour pressures p_A and p_B and the molar heats of mixing $\Delta_m H$ of regular solutions are given by the relations:

$$\left.\begin{aligned} & p_A = p_A^0\, x e^{\frac{\omega}{kT}(1-x)^2};\ p_B = p_B^0\,(1-x) e^{\frac{\omega}{kT}x^2} \\ & \text{and} \\ & \Delta_m H = x(1-x)\,Nu;\ u = \omega - T\left(\frac{d\omega}{dT}\right) \end{aligned}\right\} \quad (1)$$

where p_A^0 and p_B^0 are saturated vapour pressures of the pure components A and B respectively at temperature T° K, x, the mole fraction of the component A in the mixture and ω, the interchange free energy.

Some data are available (Porter[2]; Zawidzki[3]; Scatchard[4]) for the partial vapour pressures of binary liquid mixtures. However, due to experimental difficulties involved, these determinations are beset with uncertainties. The only measurements of sufficient accuracy, suitable for comparison with the *quasi*-lattice theory, available upto this time are those of Scatchard[4] on mixtures of benzene/carbon tetrachloride and cyclohexane/carbon tetrachloride. Recently accurate measurements of the heats of mixing of the above two systems have been made by Cheesman and Whitaker[5] and Adcock and McGlashan.[6] Their results are in good agreement with theory.

We have been exploring the suitability of the available data of the boiling points for comparison with the *quasi*-lattice theory and the evaluation of the thermodynamic properties of various regular binary mixtures with reasonable accuracy. This note deals with the boiling points of benzene/carbon tetrachloride mixtures.

If we consider the mixture as an ideal solution, the total vapour pressure of the mixture at any temperature T can be written as

$$p_t = p_A^0 x + p_B^0\,(1-x) \quad (2)$$

where p_t is the total vapour pressure of the mixture, and A and B stand for benzene and carbon tetrachloride respectively. The saturated vapour pressures of benzene and carbon

tetrachloride are given by the relations of the type

$$\log_{10} p_{mm} = -\frac{\alpha}{T} + \beta$$

Using Young's values[7] of the constants in the above equation for benzene and carbon tetrachloride in the temperature range 76-80° C., we have computed numerically the temperatures at which the total vapour pressure of the mixture becomes one atmosphere (*i.e.*, the boiling points of the mixtures under atmospheric pressure) for different composition of the mixtures. The broken line (*a*) in Fig. 1 shows the variation of boiling points of the mixture with composition obtained from equation (2).

On the *quasi*-crystalline model the total vapour pressures are given by

$$p_t = p_A^0 x e^{\frac{\omega}{kT}(1-x)^2} + p_B^0 (1-x)\, e^{\frac{\omega}{kT}x^2} \qquad (3)$$

The full line curve (*b*) in Fig. 1 shows the variation of boiling points with composition obtained from relation (3) using Young's data for p_A^0 and p_B^0 and Scatchard's value for ω.

$$\omega = 71{\cdot}8 \text{ cal/mole at } 70° \text{ C.}$$

and

$$\frac{d\omega}{dt} = -0{\cdot}15 \text{ cal/deg mole.}$$

The curve (*b*) obviously represents accurate boiling points since Scatchard's values of ω are known for their great accuracy in representing the partial pressures of benzene/carbon tetrachloride mixtures. Observed experimental boiling points of the same mixtures are shown by triangles in Fig. 1. Excellent agreement between the experimental and calculated points is noticed.

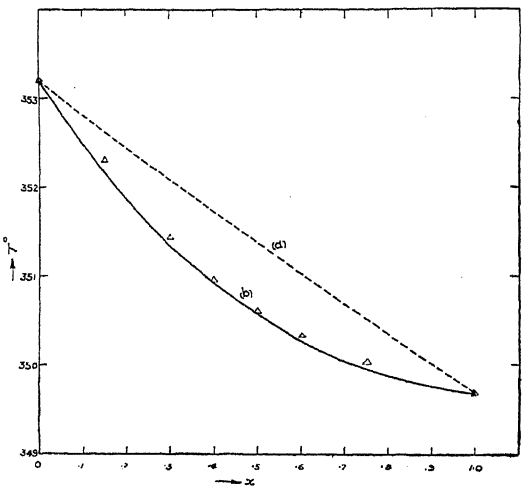


FIG. 1. Variation of boiling point with composition in mixtures of benzene and CCl_4. x is the fraction by weight of CCl_4. Curve (*b*) is obtained from Eqn. (3), while the triangles are the experimental points.

These considerations show that these boiling point measurements can be used to evaluate the interchange energy and hence thermodynamic properties of regular solutions with reasonable accuracy. It is thus possible to extend the *quasi*-crystalline model to regular solutions for which neither partial pressures nor heats of mixing of sufficient accuracy are still available. It would be interesting to compare the molar heats of mixing thus obtained with those directly determined from experiments whenever such data becomes available. Experimental determination of molar heats of mixing for different regular mixtures is being taken up.

Our thanks are due to Professor D. S. Kothari for his interest in these investigations.

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DIPOLE MOMENT OF 2:4 DINITROFLUOROBENZENE

THE dipole moment of 2 : 4-dinitrofluorobenzene is calculated using the method previously given by the author[1,2] assuming the moments of the monosubstituted compounds as $m_{c1} = 1{\cdot}45$ and $m_{c2} = 3{\cdot}90$[3]. The value of 3·56 D so obtained is in good agreement with the experimental value of 3·55 D observed in solution in benzene at 30° C. The dielectric constants are measured at a frequency of 1 Mc/s. using a resonance method of the type described by Le Fevre and Russel.[4]

Full details will be published elsewhere.

Physics Dept., D. V. G. L. NARASIMHA RAO.
Andhra University,
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EFFECT OF SOLAR ECLIPSE OF 20TH JUNE 1955 ON LONG DISTANCE SHORTWAVE TRANSMISSIONS

STUDY of the Ionosphere during a solar eclipse is an important means of ascertaining the source of ionising radiation on the solar disc. With a view to study the effects of the solar eclipse of 20th June 1955 on the Ionosphere, field strengths of C.W. transmissions from Radio Ceylon (distance 1,300 Km.) on 9·52 Mc/sec. were recorded at Waltair (Lat. 17° 41') during the eclipse day and a few days before and after the eclipse using Hallicrafters type SX-42 receiver with a D.C. amplifier and a pen-recording equipment.

The eclipse was total at Colombo. The first hop reflection point falls at about Madras where the beginning of the eclipse is reported to be at 0711 hr. (I.S.T.). The maximum phase of 86% was reached at 0816 hr. and the end was at 0930 hr. Records were taken in the morning hours between 0700 to 1000 hr. and also during night time with the same setting of the gain controls so as to get the reference signal strength when it is at its maximum. The average of signal strength received on days other than the eclipse day are plotted against time and is shown in Fig. 1. The night value of signal strength is also shown as a reference level. The values of the signal strength obtained on the day of eclipse are plotted on the same graph.

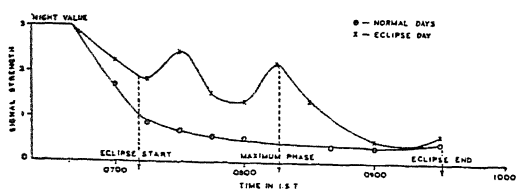


FIG. 1

It can be easily seen from the graphs that the signal strength on the eclipse day is about 30% higher than the normal value even at 0700 hr. when the optical eclipse has not started. It appears from this record that the effect on the absorbing layer is felt even before the optical eclipse started probably because of the eclipsing effect on the Corona which sets in earlier.

A peculiar feature observed in this record is the strong dip of signal strength at about 0800 hr. A strong maximum in the signal strength is noticed at 0816 hr. which is the time of maximum phase of the eclipse. The signal strength at this time is about 4·5 times the value that is usually observed in the normal days at that time. The intensity is about 72% of the night value. A rapid fall of the intensity reaching almost the normal value at about 0900 hr. was observed although the ending of the eclipse is at 0930 hr.

Many of the previous investigators[1,2] observed a definite decrease of ionisation densities of both E and F_1 layers during the solar eclipse. Using highly oblique incidence C.W. transmissions during solar eclipse some of the previous investigators observed a rise of signal strength[3] and some others[2] observed a fall of the same. This controversy indicates that the non-deviative D-region absorption has only a little role in causing the above changes of signal strengths.

The fall of signal strength during morning hours in the normal days is due to the growth of E layer ionisation which tends to obscure the F_1, F_2 reflections as judged from the critical frequency data for this month. But during the eclipse period due to the fall of E layer ionisation F_1 and F_2 reflections will be predominant along with the single hop E reflection and this causes considerable rise in the signal strength. Part of this rise in signal strength might have also been contributed by decrease in D-region absorption. The dip of the signal strength at about 0800 hr. is very probably due to the passage of a sporadic E cloud across the propagation path as in the summer month of June the frequency of occurrence of E_s with $f_o E_s$ between 3 Mc/sec. and 5 Mc/sec. is as high as 25 days in a month at this time as reported from Ahmedabad Ionosphere station.

Another interesting feature of this record soon after the commencement of the eclipse is the setting in of a quick and most uniform periodic pattern all of a sudden. This sudden change occurred 7 minutes after the start of the eclipse at the first hop reflection point and continued upto 0900 hr. This quick periodic fading during the eclipse is most probably due to the rapid rise in the level of F_1 layer with respect to E causing a continuous change of path difference between single hop E and F reflections. Full details of this investigation will be published elsewhere.

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DIELECTRIC PROPERTIES OF AMINES AND METHYLENE CHLORIDE AT 3·38 CM.

THE electric susceptibility of ten organic molecules at some frequencies in 3 cm. range has been measured in this laboratory and has been reported. Improvement has been made in the previous technique,[1-3] thereby increasing the sensitivity considerably. In this improved technique the microwave radiations are modulated by 20 Kc/s. sine waves. The detected power is amplified by tunable indicating amplifier and fed to a.c. meter which measures the power. The diagram below shows the improved technique for measurement of electric susceptibility.

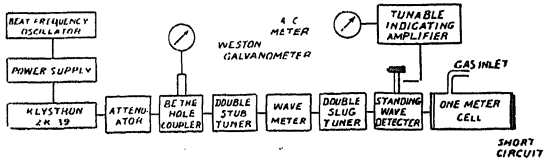
The electric susceptibility of a number of amines [CH_3NH_2, $(CH_3)_2NH$, $C_2H_5NH_2$, $(C_2H_5)_2NH$] and methylene chloride (CH_2Cl_2) has been measured by the improved technique. All the chemicals were obtained in the pure form and were passed through dehydrating tower before entering the waveguide cell. The values are shown in Table I.

TABLE I

Variation of dielectric constant with pressure (Tde wave-length of the radiation was 3·38 cm. The table lists the values of δ, the electric susceptibility and is expressed in units of 10^{-3}; temperature 31° C.)

Gas	Pressure in cm. of Hg							
	10	20	30	40	50	60	70	Atm.
CH_2Cl_2	0·86	1·56	2·25	..	..	..	..	..
CH_3NH_2	0·55	1·37	1·71	2·27	2·90	3·46	4·04	4·42
$(CH_3)_2NH$	0·40	0·86	1·32	1·80	2·30	2·78	3·28	3·51
$C_2H_5NH_2$	0·76	1·48	2·20	2·97	3·74	4·41	5·13	5·42
$(C_2H_5)_2NH$	0·69	1·22	..	..	..	..	..	..

It is found that δ varies linearly with pressure. The result is in conformity with Van Vleck and Weisskopf's expression[4] for δ, under the condition $|\bar{\nu} - \bar{\nu}_0| \gg \overline{\Delta\nu}$, where $\bar{\nu}$ (cm.$^{-1}$) is the frequency of the wave, $\bar{\nu}_0$ (cm.$^{-1}$) is the resonant frequency of the molecule and $\overline{\Delta\nu}$ is the half-width parameter. This is the case when $\bar{\nu}$ is far removed from $\bar{\nu}_0$ The resonant frequency of methylene chloride and methyl amine are known. They are all above 20 Kmc/s.



In other cases we can conclude that the resonant frequency is far removed from 3·38 cm. at which observations have been made.

I am thankful to Shri Krishnaji, for his guidance and to Dr. Prem Swarup and Shri Shanker Swarup for their help in the work. Thanks are also due to the Council of Scientific and Industrial Research for financial assistance.

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SPECTROGRAPHIC ANALYSIS OF SOILS IN THE COPPER ARC

CARBON electrodes are often used for the estimation of most of the micro-elements in soils.[1] The determination of boron, however, presents a special problem requiring the use of copper electrodes as boron forms an impurity which cannot be easily removed from carbon. While standardising the technique for the estimation of boron in soils, it was thought desirable to find the possibility of estimating along with it a few other important micro-elements, namely, manganese and zinc. Preliminary results obtained by the method where pre-chemical treatment of the samples is avoided are recorded below.

Thirty milligrams of the soil sample finely ground in an agate mortar were added to an equal amount of pure aluminium oxide to which 1·09% of bismuth and 1·86% of cadmium were added as internal standards. The components were thoroughly mixed before filling the material in the electrodes. Copper rods (J.M.) 5·0 mm. diameter were shaped at the top 3·0 mm. into 2·5 mm. diameter and a cavity of 1/16" diameter and 3·0 mm. depth was made in it. The sample was filled in the cavity of the electrode (cathode) and arced at a current of 5·0 amperes using 220 volts D.C. Stepped spectra were recorded on Ilford 'Chromatic' plates using Hilger's Automatic Large Quartz Spectrograph. The plates were developed in a constant temperature-bath at 18° C. Intensities of the lines were measured using a non-recording microphotometer and proper background corrections were made.[2] Using the working curves drawn (almost straight lines), boron and manganese could be estimated down to 5 p.p.m.

and 30 p.p.m., respectively while zinc could not be estimated below 100 p.p.m., though their detection limits are much lower, namely, 1-2, 20 and 50 p.p.m. respectively. Recoveries of these elements added to the synthetic soil of the composition SiO_2 61·0%, Al_2O_3 19·4%, Fe_2O_3 4·8%, Na_2CO_3 3·4%, K_2CO_3 2·7%, CaO 1·9%, $MgSO_4$ 5·8%, TiO_2 1·0%, are given in Table I. Average of duplicates usually closely agreeing were taken. The wave-length of the lines used are given in brackets.

TABLE I

Recovery of micro-elements added to synthetic soil

Micro-elements	Internal Standard	Content of Manganese in p.p.m.	
		added	recovered
B (2497·7 Å)	Ei (2898·0 Å)	223	228
		46	45
Mn (2794·8 Å)	Bi (2898·0 Å)	208	210
		66	70
Zn (3345·0 Å)	Cd (3403·6 Å)	208	220

Manganese status of different samples of soil as estimated by this method is compared with the values obtained using chemical method in Table II. Values recorded are results of single determinations.

TABLE II

Manganese content in soil samples as estimated by spectrographic and chemical methods

Soil sample No.	Content of Mn in p.p.m. obtained by	
	Spectrographic method	Chemical method*
1	1480	1360
2	1320	1200
3	950	860
4	750	720
5	925	870
6	560	609
7	607	642

* The first five values were worked out by Shri O. P. Dhameja and the last two by Shri R. K. Chatterji and Dr. N. R. Datta Biswas.

The results recorded indicate that within 10% variation there is agreement between the spectrographic and chemical methods of estimation. In most of the Indian soils, as the manganese and boron contents are much higher than the lower limits of estimation, the copper arc method developed is being used as a rapid routine method of analysis in this laboratory. Zinc could be detected in soils only at a level of 300 p.p.m. using the cathode layer arc technique while the anode excitation method[3] made the detection possible at a level of 50 p.p.m. The results recorded in the present investigation compare very favourably with those obtained by anode excitation. Further work on the possibility of using this technique for the estimation of other elements is in progress.

The authors record their grateful thanks to Dr. B. P. Pal and to Dr. S. P. Raychaudhuri for their interest in the progress of the work.

Indian Agric. Res. Inst., New Delhi, *October* 22, 1955.

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V-SHAPED STRUCTURES IN THE JHIRI SHALES*

THE Jhiri shales of the Rewa series together with the other beds of the Vindhyan System in Bundelkhand are practically horizontally bedded sediments. They are devoid of any more complex structural features, even gentle folds or steep dips being altogether absent. However, in the open-cast pits of the Shahidan diamond mine near Panna in Vindhya Pradesh some peculiar V-shaped structures are seen in these shales. These are confined to



FIG. 1. V-shaped structure seen in the Jhiri shales exposed in a pit in the Shahidan diamond mine, Panna. The apparent curving of the beds where the men are standing is due to the circular wall of the pit.

the top layers of the formation and go down only a few feet from the surface. From a casual glance they appear like vertical isoclinal synclines (Fig. 1), but a close inspection reveals that they are not folds but are actually wedge-shaped vertical depressions or cracks in the otherwise horizontal sediments. In transverse section (Fig. 2) it is seen that the shale

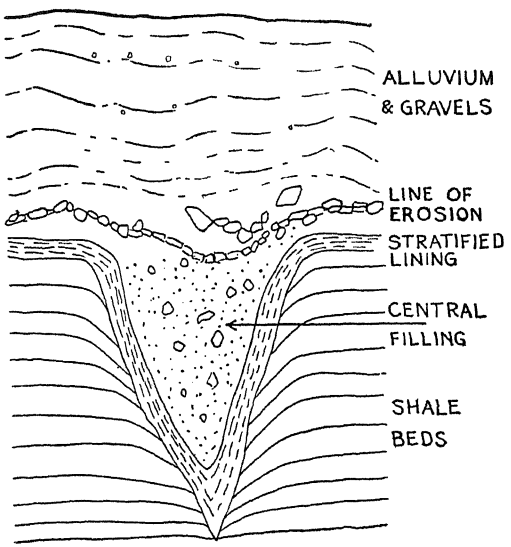


FIG. 2. Diagrammatic sketch of a cross-section of the fully developed crack shown in Fig. 1. It shows the horizontal shale turning slightly downwards adjacent to the crack, stratified lining layer, and unstratified central filling of alluvium, gravel and rock boulders.

laminæ tend to turn slightly downwards adjacent to the depression, which has a stratified lining that appears to be the folded portion of the topmost shale layers and gives the impression of a syncline. This lining is generally less than a foot in thickness, while the depression is generally 10 to 12′ deep but sometimes much less. The top of the structure is 5 to 8′ wide, and the depression is filled with unstratified alluvium, gravel and boulders. The soil mantling this formation is also somewhat stratified and gently undulating.

Paterson[1] and Leffingwell[2] have studied similar structures which they ascribe to *frost action* in Arctic climate. The same mechanism probably has also given rise to these cracks in the Jhiri Shales. They do not appear to be folds formed by moving ice as suggested by Ahmad.[3] They are also unlike similar cracks formed by desiccation in hot climates, which, according to Smith,[4] are narrow in proportion to depth and the wall rocks do not show any marginal distortion.

I am thankful to my colleague Mr. B. N. Raina with whom I have profitably discussed this note.

Northern Circle, S. M. MATHUR.
Geological Survey of India,
Lucknow, *August* 18, 1955.

* Published by permission of the Director, *Geological Survey of India*.

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ORIGIN OF INDIALITE (CORDIERITE) BEARING AND OTHER VITROPHYRIC AND HORNFELSIC ROCKS

A. MIYASHIRO AND T. IIYAMA[1] have discovered a new hexagonal mineral in the "fused sediments (so-called para-lava)" of Bokaro Coalfield, India $(Mg\ Fe^{++})_2\ Al_4Si_5O_{18}$ in composition polymorphic with cordierite. This mineral has been identified hitherto as cordierite, but the X-ray analyses led them to identify it as a new mineral and they have proposed the name "indialite" to it. Similar indialite-bearing vitrophyric and hornfelsic rocks have been observed at the contact of mica-lamprophyre intrusions by the authors of this note at many localities in the Jharia and Raniganj Coalfields, but two localities have been particularly chosen, one along the XIV seam, Chasnala Colliery, Jharia Coalfield and another along the Ramnagar seam, Victoria West Colliery, Raniganj Coalfield, because the geological setting of these vitrophyric and hornfelsic rocks are interesting from the point of origin.

At Chasnala area the indialite-bearing and plagioclase-bearing vitrophyric and hornfelsic rocks are closely associated with the burnt shale due to recent outcrop coalfire and occur adjacent to a mica-lamprophyre sill. In the Victoria West Colliery, the indialite-bearing vitrophyric and hornfelsic rocks occur as xenoliths in the mica-lamprophyre (peridotite) sill at the 14th level (684·75′ below surface level). The water-table in this mine occurs below a depth of 50′ from the surface. In these vitrophyric and hornfelsic rocks, indialite is often associated with sillimanite, tridymite and spinel. The form, twinning and optical properties of this mineral have been described in detail by Venkatesh[2] and P. R. J. Naidu[3] who have termed this mineral as cordierite. In a preliminary

paper contributed to the Indian Science Congress, the authors of this note[4] also identified this mineral as cordierite. The indialite-bearing vitrophyric and hornfelsic rocks are probably more basic than the associated shales, as can be seen from their mineralogical composition. None of the burnt shales due to recent outcrop coalfire at Chasnala Colliery contain indialite.

The origin of the indialite-bearing vitrophyric and hornfelsic rocks was attributed to the burning of coalseams at their outcrops by forest fires by Fermor[5] and later by Chatterjee and Ray.[6] They considered that these rocks are 'para-lavas'. Sharma and others[7] opined that these vitrophyric and hornfelsic rocks have formed due to some intermingling of the fused shaly rocks and mica-lamprophyre. The geological setting of the indialite-bearing vitrophyric and hornfelsic rocks adjacent to the mica-lamprophyre sills in the Jharia and Raniganj Coalfields, the universal occurrence of indialite in the vitrophyric and hornfelsic rocks, the absence of this mineral in the burnt shales due to recent outcrop coalfire and the occurrence of these rocks very much below the water-table have led the authors of this note to suggest that the origin of these rocks is more likely due to the metamorphism and metasomatism that the pelitic sediments have undergone at the contact of the mica-lamprophyre sills. It is difficult for the authors to decide at this stage which of the three process, namely, basification during reciprocal reaction or metamorphic differentiation or metamorphic segregation, operated in the origin of the indialite-bearing vitrophyric and hornfelsic rocks.

The authors wish to express their grateful thanks to Bengal Coal Co., Ltd., for affording permission and facilities to study the underground geology of the Victoria West Colliery.

Dept. of Geology, Indian School of Mines & Applied Geology, Dhanbad, *August* 25, 1955.

M. S. SADASHIVAIAH.
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MARINE SEDIMENTS OFF KALINGAPATAM ON THE EAST COAST OF INDIA

IN their studies on marine sediments off the east coast of India, Mahadevan and Poornachandra Rao[1] observed that sillimanite, zircon, monazite, garnet and green pyroxene are the major heavy mineral components in sediments from Waltair to the mouth of the Ganges. They have also delineated a zonal pattern (sand, clay, shell and concretion zones) in the constitution of the sediments of the continental shelf off Visakhapatnam.

Twenty-four representative samples of shelf sediment collected off Kalingapatam, on the east coast of India (Fig. 1), were subjected

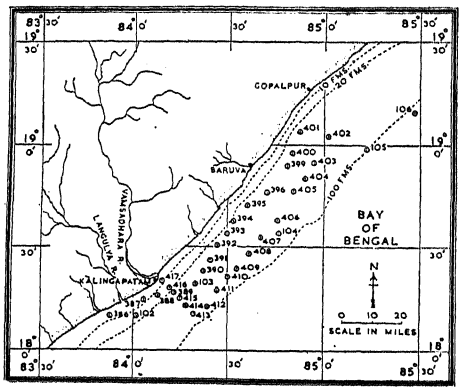


FIG. 1. Location map of sampling stations.

to detailed examination including mechanical analysis, heavy mineral studies, and determination of carbonate content. It is found their size distribution and mineralogical constitution are markedly different from those samples collected from similar depths in other areas.

Size Distribution.—A trilinear diagram[2] of all sediments, using as the three poles, (*i*) material finer than 0·063 mm. (silt and clay), (*ii*) material between 0·25 and 0·063 mm. (fine sand), and (*iii*) material coarser than 0·25 mm. (medium sand and granules) divides these sediments into five classes as illustrated in Fig. 2.

The very fine-grained silty sands of reddish hue from depths of 5-20 fathoms opposite Kalingapatam form a well-defined group (Class A, Fig. 2) and fall along that side of the triangle representing the absence of coarse particles, the mud content increasing with depth. North of Kalingapatam these sediments show a progressive change in both colour and particle size distribution. There is decrease in the percentage of silty sands with correspond-

ing increase in coarse-sand percentage, with the result that they fall just outside the zone of Class A sediments. Samples collected at depths of 20-40 fathoms constitute a separate group (Class B) occupying the central triangle formed by the 20% lines. Deep water sediments from depths between 40-60 fathoms are grouped under Class C and they occur along

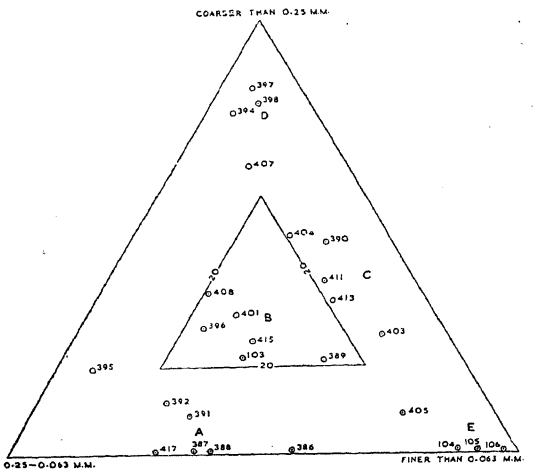


FIG. 2. Size composition of samples.

that line representing 20% fine sand. These samples contain more than 65% shells by volume of the total. Beyond depths of 60 fathoms occur grey-coloured plastic clays and these constitute a group (Class E) by themselves. The very coarse sediments from two isolated patches comprising 394 and 407* and 397 and 398 respectively form a well-defined and non-overlapping group (Class D). These consist very largely of coarse sand with some silty sand and very little clay.

Mineralogical Composition.—Sediments of the Class A contain about 95% quartz with a little felspar, the rest being made up by biotite, black opaques, garnet, sillimanite and a few grains of monazite, pyroxenes and amphiboles. Biotite content decreases in proportion with increase in distance from Kalingapatam. Garnet, black opaques, sillimanite and white mica in finer fractions are found in varying proportions in all the other sediments. The total heavy mineral content constitutes 10-15% of total sand fraction, the maximum concentration being found in samples from the two isolated sandy patches.

Carbonate Content.—Percentage loss in weight due to digestion of the sediment in 1 : 1 dilute hydrochloric acid is taken to be a measure of carbonate content, which is largely in the form of shell fragments.[3] Sediments of Class A contain only 3% carbonate and these appear to be unfavourable for the thriving of organic life; those of Class B contain 25-36% carbonate; those of Class D contain less than 10% carbonate. Sediments of Class C contain more than 60% carbonate in the form of shells and concretions.

In the light of these observations, the following conclusions are warranted: (1) The silty sands containing significant amounts of biotite are perhaps a part of sediment load discharged by Vamsadhara and Langulya, the only major rivers in the area under investigation. (2) Based on grain size distribution and carbonate percentage, the sediments of the shelf environment can be grouped into: (*a*) Silty sands, between 5-20 fathoms; (*b*) Medium-grained sands with considerable amount of shells, between 20-40 fathoms; (*c*) Shell zone, between 40-60 fathoms; and (*d*) Clay zone, beyond 60 fathoms. (3) Further studies are required to explain the anomalous occurrence of the two coarse-sandy patches.

The investigations were sponsored by the Council of Scientific and Industrial Research.

Dept. of Geology, Andhra University, Waltair, *November* 9, 1955.

C. MAHADEVAN.
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* These numbers refer to the location of the samples.

PEROXIDE OF TITANIUM

THOUGH peroxide of titanium has been known since Weller first prepared in 1882, a controversy exists regarding its composition. Weller,[1] Classen,[2] Levy[3] and Schwarz and Sexauer[4] have shown that the peroxide has the molar ratio of $TiO_2 : O$ (active) as 1 : 1 corresponding to the formula TiO_3, but the work of Billy[5] and Billy and San Galli[6] gives the composition as Ti_2O_5. While attempting to prepare a sample of pure titanium peroxide, it was found that both TiO_3 and Ti_2O_5 could be obtained, the latter being formed on keeping the former for some days. In view of the controversy about the composition of the peroxide, the present investigation was carried out.

Hydrated peroxide of titanium was prepared by addition of 10% ammonia to an aqueous

mixture of purified titanium tetrachloride and hydrogen peroxide ($TiO_2 : H_2O_2 = 1 : 1{\cdot}2$). Addition of excess of ammonia was avoided. The light yellow precipitate, thus obtained, was washed several times with distilled water till free from chloride. The slurry was then analysed for titanium dioxide by ignition. The active oxygen was determined in another aliquot by treating the slurry with acidified potassium iodide and estimating the iodine liberated. The results of analysis showed that the pertitanic acid thus prepared had the composition $TiO_3.xH_2O$ with only traces of TiO_2 (2%) as impurity.

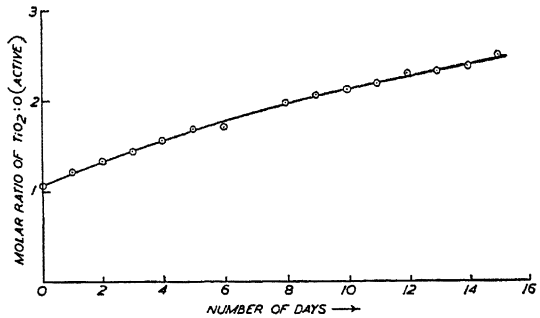
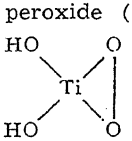


FIG. 1

The keeping quality of the wet peroxide was studied by periodically analysing the slurry. The results are graphically represented in Fig. 1. From the figure, it is seen that the ratio of $TiO_2 : O$ (active) is approximately 1 : 1 in the fresh precipitate corresponding to the composition TiO_3. It is further seen that the pertitanic acid $TiO_3.xH_2O$ goes on losing active oxygen on keeping and after 8 days the composition corresponds to the formula Ti_2O_5. It is interesting to note that the loss of oxygen does not stop with the formation of Ti_2O_5 but continues further. After about 3 months, the pertitanic acid completely decomposed to titanium dioxide.

Thus, the present investigation shows that the peroxide Ti_2O_5, as obtained by Billy and San Galli,[6] is an intermediate decomposition product of TiO_3. Reaction of freshly prepared titanium peroxide with oxalic acid has shown that the former has only two replaceable hydroxyl groups, indicating the following ring structure for the peroxide (pertitanic acid).



This view is in agreement with the structure of peroxy compounds of thorium and zirconium.[7]

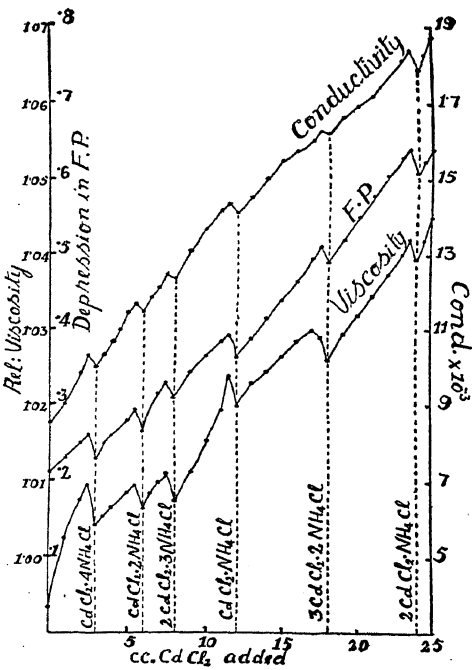
The authors wish to thank Prof. K. R. Krishnaswami and Dr. M. R. A. Rao for their keen interest in this investigation.

Dept. of Gen. Chem., D. P. KHARKAR.
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FORMATION OF COMPLEX COMPOUNDS BETWEEN CADMIUM CHLORIDE AND AMMONIUM CHLORIDE

G. C. WITTSTEIN[1] AND K. VON HAUER[2] found that cadmium oxide, hydroxide, or carbonate dissolved in a solution of ammonium chloride with evolution of ammonia, and on evaporation, the solution furnished crystals with very variable proportions of ammonium and cadmium chlorides. Following this observation, efforts were made by various workers to elucidate the composition of the compounds formed. But no systematic study has yet been made.



So it was thought desirable to take up the work.

A.R. grade cadmium chloride and ammonium chloride were dissolved to form M/4 solutions. A series of mixed solutions were then carefully prepared, in which the concentration of one of the constituents was kept constant while the other varied systematically following the method of Nayar and Pande.[3] Each of these solutions was then subjected to careful study by conductivity, density and viscosity, and freezing point measurements. The results are shown graphically. From the graph it is clear that by all the methods six definite breaks are observed at the points corresponding to the formation of the compounds $CdCl_2$. $4\,NH_4Cl$, $CdCl_2$. $2\,NH_4Cl$, $2\,CdCl_2$. $3\,NH_4Cl$, $CdCl_2$. NH_4Cl, $3\,CdCl_2$. $2\,NH_4Cl$ and $2\,CdCl_2$. NH_4Cl. Further work with respect to the formation of complexes between cadmium halides and the corresponding alkali halides is in progress.

Chemical Labs., K. G. KAIMAL.
The University, Saugor, A. K. BHATTACHARYA.
November 3, 1955.

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ROLE OF CARBONIC ANHYDRASE IN THE FEMALE GENITAL DUCT OF THE APPLE SNAIL

THE possible role of carbonic anhydrase in the deposition of carbonate in shell was first suggested by Meldrum and Roughton.[1] Common[2] studied this enzyme in the oviduct of hen and concluded that the activity of this enzyme is higher in the uterine epithelium than in the remaining oviductal tissue, and that it might play a part in the secretion of the egg-shell. More recently Freeman and Wilbur[3] and Wilbur and Jodrey[4] studied the carbonic anhydrase activity in the mantle tissue of the molluscs and suggested the possibility of the importance of this enzyme in shell-formation. The present note deals with the study of the distribution of carbonic anhydrase in the female genital duct of the apple snail *Pila virens* (Lamarck) with special reference to the formation of the egg-shell.

For the estimation of carbonic anhydrase the colorimetric method of Brinkman[5] was adopted, which consists in measuring the time taken for a given amount of the enzyme to produce a measured shift in the pH under standard conditions and in the presence of a suitable excess of sodium carbonate. Calcium in the tissue was estimated after ashing the tissue by the oxalate method described by Hawk *et al.*,[6] and the alkaline phosphatase activity of the tissue was estimated by the method of Kind and Mary.[7] In every experiment rigorous controls of boiled extracts were used.

The uterine and vaginal tissues were tested for carbonic anhydrase activity. It was observed that in the vaginal tissue of the female genital duct there is a high carbonic anhydrase activity which reaches the maximum about the time of oviposition. During the period of hibernation there is a very feeble carbonic anhydrase activity. In the uterine tissue the carbonic anhydrase activity is very weak. An examination of the male genital duct has shown a complete absence of this enzyme.

A study of the distribution of calcium in the soft parts of *Pila*[8] has shown that the vaginal tissue contains a large amount of calcium. It has also been observed[9] that there is a sudden rise of calcium and alkaline phosphatase in the vaginal tissue about the time when the animal burrows just before ovipos'tion, and that the egg-shell which consists of about 92% of calcium carbonate is formed entirely in the vaginal region. Table I shows the relation between the distribution of calcium, alkaline phosphatase and carbonic anhydrase in the vagina in the breeding season at different stages.

TABLE I

State of animal	Calcium in mg. per animal	Phosphatase activity*	Carbonic anhydrase activity†
Breeding season ..	108	12·4	2·9
Just before oviposition ..	190	20·2	8·1
After oviposition ..	78	10·2	1·8

* Phosphatase activity is expressed as mg. of phosphorus liberated by a gram weight of the tissue during 2 hours of incubation.

† Carbonic anyhydrase activity is expressed as the ratio of the time of reaction in the heated and unheated extracts.

Thus the great increase in the carbonic anhydrase activity in the vaginal tissue before oviposition finds a parallel in the calcium content of the tissue during the same period. This is strongly suggestive of the possible role of carbonic anhydrase in the formation of the egg-shell of *Pila*.

My thanks are due to Professor R. V. Seshaiya for guidance, and to the Government of India for the award of a senior research scholarship.

Dept. of Zoology, (Miss) V. R. Meenakshi.
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September 1, 1955.

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THE FOOD OF HORSE-MACKEREL *CARANX*

The Horse-Mackerel known as *Parai* in Tamil ranks high among the food fishes in and outside Madras City, and constitutes an important fishery. Chacko[1] has studied the feeding habits of *Caranx hippos* and *Caranx sansun* and found that they feed mainly on teleostean food such as *Leiognathus* sp. and *Stolephorous* sp. Much work has to be done regarding the food of Horse-Mackerels. One hundred and twenty-eight specimens of *Caranx djedaba* were examined from September 1953 to May 1955. This species enters Madras waters about September of each year and migrates elsewhere in May. The data collected show that this fish uses the Madras area as feeding ground and breeds elsewhere.

Except 16 fishes, all had food in the stomach. It is significant to note that these fishes feed less during the immature stages than when they are mature. Table I, based on 128 fishes, illustrates this fact.

Table I

Showing the condition of feed and the length of the fishes examined during the mature and immature stages

Condition of feed \ Length of fishes	10–14 cm.		15–20 cm.		21–25 cm.	
	(*a*)	(*b*)	(*a*)	(*b*)	(*a*)	(*b*)
Empty	2	3	3	6	..	2
Little	1	4	2	7	..	4
¼	..	7	1	8	1	3
½	9	2	4	2	..	5
¾	7	1	8	2	7	..
Full	8	2	10	..	4	3

(*a*) Mature; (*b*) Immature.

The stomach contents were analysed and measured and the data obtained are given in Table II.

From Table II it will be clear that this fish is carnivorous and that crustacea form the main item of food. Since *Squilla* sp., *Acetes* sp., *Penœus indicus*, cumacea, megalopa, zœa stages of crab and mysis form the chief constituents it may be inferred that this fish is actively predacious and feeds in midwater zones. Of the Entomostraca, only the copepods *Euterpina* sp. and *Acartia* sp. were identified. Apart from this there were also unidentifiable appendages and other remains of crustacea. The teleosteans were observed to form a minor part of the diet when compared with the quantity of crustacea that the fish had consumed. Fish eggs, scales, pectoral girdle, parts of anal fin were also found in the stomach. Species of Clupeidæ and Engraulidæ were the most frequent teleostei on which the fish feeds. Only rarely polychætes occurred in the stomach and it was in the month of October, December and April. Since the polychætes are digested very easily and only setæ are left, no specific identification could be made. Whenever polychætes

Table II

Showing the average volume of food and also the percentage average of the various food items of Caranx djedaba

Particulars	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May
Vol. of stomach content in c.c.	0·5	0·3	0·4	0·3	0·4	0·5	0·5	0·5	0·3
Crustacean item	69·5	92·0	82·6	80·0	77·4	88·9	73·3	71·1	79·5
Teleostean item	25·5	4·1	15·7	15·4	17·5	10·1	12·8	21·5	15·3
Polychætes	..	2·6	..	1·3	..	..	..	3·3	..
Sand particles	..	1·3	..	1·2	..	..	..	1·9	..
Other food items	5·0	..	1·7	2·1	5·1	..	13·9	2·2	5·2

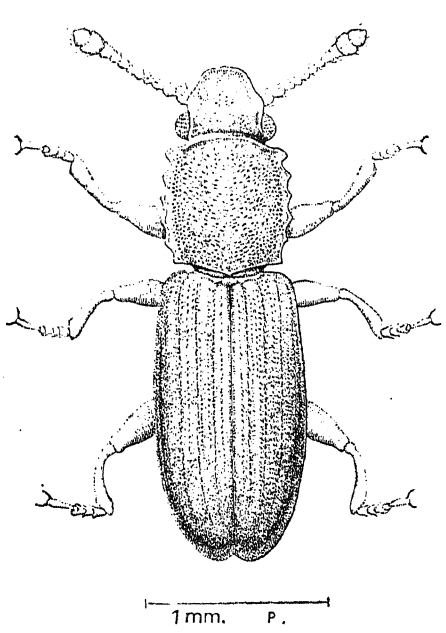


FIG. 1.

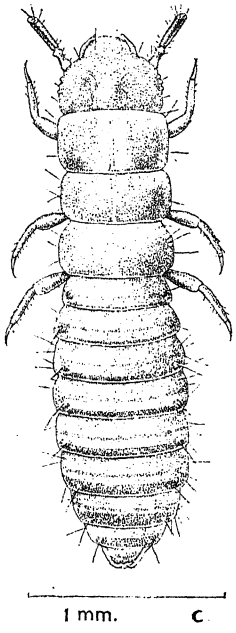


FIG. 2.

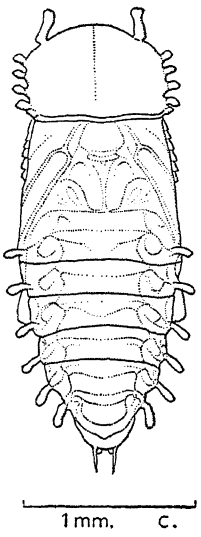


FIG. 3.

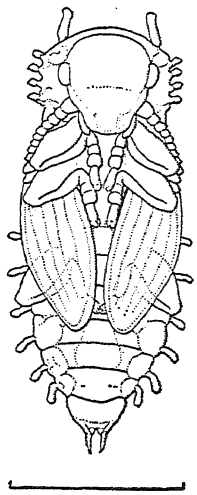


FIG 4.

Fig. 1. *Silvanus iyeri* var. *mysorensis*—adult. Fig. 2. Full-grown larva of *S. iyeri* var. *mysorensis*.
Fig. 3. Pupa of *S. iyeri* var. *mysorensis*—dorsal view. Fig. 4. Ventral view.

Mysore could not be undertaken as it required feeding it on other species which were not available in quantity. The presence of a dark brown variety, peculiar to Mysore, requires the creation of a new name for it and has been designated accordingly.

Biochemistry Division, S. MAHDIHASSAN.
Council of Scientific Research,
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INHERITANCE OF FILAMENT COLOUR IN TOBACCO

FILAMENT colour in tobacco is normally green. But there are many types which have pale or light yellow and white filament. In rare cases pink filaments are also found. In our collection there are types with fully pink filaments and those in which filament has a pink wash confined to the tip only. Among the fully pink types the intensity of the colour varies from faint to deep pink.

Kelaney[1] dealing with a fully pink filament type reported that the pink colour is controlled by two complementary genes giving a ratio of 9 pink : 7 green. In a cross between two flue-cured varieties, Kadam and Murty[2] found that an inhibitor, controlling the filament tip colour, was operating giving a ratio of 13 colourless to 3 coloured. In their cases, the pink wash was confined to the tip of the filament just below the attachment to another. We present now a third case where the filament tip colour is controlled by two complementary genes.

Lanka, an indigenous petiolate type, was crossed with a Turkish petiolate variety in 1950-51 with a view to increase the leaf-number of the *Lanka* tobacco. The *Lanka* variety has pale filament while the other type has a pink wash at the tip of the filament. The F_1 was petiolate and had a pink wash similar to the Turkish parent. The F_1 was grown in 1951-52 and the F_2, the next season. For confirming the F_2 behaviour, nineteen plants were selected at random for F_3 generation. In 1953-54 back-cross of the F_1 to *Lanka* and the F_2 generation were also grown again along with the 19 F_3 families. The segregations of the various generations are presented in Table I.

TABLE I

Segregation in F_2, F_3 and back-cross for filament tip colour between Lanka *and a Turkish variety*

	Observed		Expected		Total	χ^2	P
	Coloured	Not coloured	Coloured	Not coloured			
F_2 (1952–53) (9 : 7)	35	29	36·00	28·00	64	0·0635	0·80–0·90
F_2 (1953–54) 9 : 7)	41	37	43·88	34·12	78	0·4306	0·50–0·70
F_1 × *Lanka* (1953–54) (1 : 3)	48	117	41·25	123·75	165	0·1473	0·70–0·80
F_3 Families segregating 9 Coloured : 7 not Coloured							
29	46	32	43·88	34·12	78	0·2352	0·50–0·70
35	47	38	47·81	37·19	85	0·0316	0·80–0·90
38	56	40	54·00	42·00	96	0·1703	0·50–0·70
65	54	38	51·75	40·25	92	0·2236	0·50–0·70
F_3 Families segregating for 3 Coloured : 1 not Coloured							
23	67	22	66·75	22·25	89	0·0037	0·95–0·98
56	62	19	60·75	20·25	81	0·1029	0·70–0·80
58	62	17	59·25	19·75	79	0·5105	0·30–0·50
73	50	16	49·50	16·50	66	0·0203	0·80–0·90

TABLE II

	Pure for Coloured	9 Coloured : 7 Colourless	3 Coloured : 1 Colourless	Pure for Colourless	Total	χ^2	P
Observed ..	3	4	4	8	19		
Calculated (1 : 4 : 4 : 7)	1·1875	4·7500	4·7500	8·3125		3·0149	0·30–0·50

It will be seen that the F_2, F_3 and back-cross numbers agree well within the expected segregations.

Out of the 19 F_3 families, 8 bred pure for colourless condition, 4 families segregated 9 coloured : 7 not-coloured and another four gave a ratio of 3 coloured : 1 not-coloured and 3 families bred pure for coloured condition. The frequencies of the different categories of families agree well with the expectation as is seen from Table II.

The complementary genes for the pink colour of the filament are designated Fp_a and Fp_b.

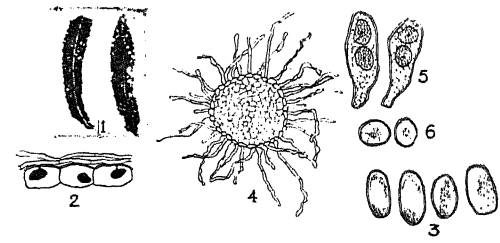
B. S. KADAM.*
B. RADHAKRISHNAMURTHY.
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* Now Director of Agriculture, Rajkot, Saurashtra.

A NEW SPECIES OF *ERYSIPHE*

AN ectophytic powdery mildew was collected by the writer in September 1954, in the vicinity of Poona on a hitherto unreported host, *Goniocaulon glabrum* Cass. The mildew not only produced thick coating of snowy white mycelium on the upper surface of leaves so characteristic of the fungus (Fig. 1), but also numerous cleistothecia.



FIGS. 1–6.—Fig. 1. Effect on leaves. Fig. 2. Section showing haustoria, × 202. Fig. 3. Conidia, × 240. Fig. 4. Cleistothecium, × 95. Fig. 5. Asci, × 240. Fig. 6. Ascospores, × 240.

TABLE I

Fungus	Conidia Size and nature	Cleistothecia diameter	Appendages	Asci No. and dimensions	Ascospores No. and dimensions	Authority
E. cichoraccarum	Catenulate 24–43·2 × 14·4–26·4 μ	84–168 μ	Long 13–35	5–15 43·2–74·4 × 25·2–45·6 μ	Two or three variable 16·8–31·2 × 12·0–19·2 μ	Homma[2]
Poona Mildew	Catenulate 22–30·6 × 13·6–17 μ	89·7–124·6 μ	Short numerous	3–5 34–59·5 × 20·4–29 μ	Two constant 10·2–17·0 μ	..

Of the three sections under which the genus *Erysiphe* has been separated by Homma[2] the Poona fungus has similarities with *E. cichoracearum* DC. A close comparison of the two fungi as presented in Table I, however, shows that the Poona fungus has several distinctive morphological features which separate it from *E. cichoracearum*. The generally smaller dimensions of conidia, ascospores, cleistothecia and their appendages, constant number (generally 4) of asci to a cleistothecium and the regularly two-spored asci clearly distinguish the Poona fungus from the *cichoracearum* type.

The Poona fungus is, therefore, described as a new species.

Erycibe poonœnsis KAMAT, SPEC. NOV.

Mycelium ectophyticum, densum, persistens, niveo-album in mass, ornatum haustoriis globuribus vel ovalibus in cellulis epidermalibus. Conidiophori simplices, breves et erecti; conidia ovata vel doliiformia, hyalina, 22·0-30·6 μ × 13·6-17·0 μ, catenata, unaquaque catena constante ex 3-5 conidiis. Cleistothecia brunnea vel fusce brunnea, globularia, 89·7-124·6 μ gregaria appendicibus myceloideis, septatis, pallide brunneis, longitudinis 39·0-136 μ. Asci ut plurimum 4, nonnumquam 3-5, ellipsodcæ, brevi pedicellati 34-59·5 μ × 20·4-29·0 μ regulariter dispositi. Ascosporæ globularibus, pallide brunneæ, 10·2-17·0 μ simper binæ in singulis ascis.

Typus lectus in partibus æreis *Goniocauli glabri* Cass. in urbe Poona, in India, a P. P. Chiddarwar.

The author is grateful to Prof. M. N. Kamat for guidance and to Mr. E. W. Mason of the Kew Mycological Institute, and Rev. Father H. Santapau for helpful suggestions and Latin diagnosis respectively.

The type specimens have been deposited at the Herbaria of the Commonwealth Mycological Institute, Kew, England, and Indian Agricultural Research Institute, New Delhi, India.

M.A.C.S. Laboratory, Law College Buildings, Poona, *July* 26, 1955. P. P. CHIDDARWAR.

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EFFECTS OF LONG PHOTOPERIOD ON FOUR EARLY-WINTER VARIETIES OF RICE

PURE grains of four early-winter varieties of rice, two varieties T. 1145 ("Usha" of Puri District) and T. 36 (a selection from No. 1 Cuttack) grown in Orissa and the other two T. 23 ("Kala Sukhadas" of Banda District) and T. 17 ("Bansi" of Allahabad District) grown in Uttar Pradesh were sown in seed-bed pots on June 18, 1949. The 24-hour long photoperiod (obtained by supplementing the natural day-length with artificial illumination from a 500-watt gas-filled Osram bulb hung at a height of 5′ from evening to morning) was given to 7-day-old seedlings for 3 weeks in one set and for 6 weeks in another. A third set was all along kept as control which received the normal day-length prevalent in the growing season. The seedlings in all the sets were transplanted to bigger pots at the age of 49 days and were kept till harvest in the open pot-culture enclosure. Each set had 6 pots with 4 plants per pot. The experimental results are presented in Table I.

A study of Table I leads to the following salient points: Continuous illumination for 3 weeks in the seed-bed had no effect on the onset of flowering, but treatment for 6 weeks on the average had slightly delayed the ear emergence. All the varieties did not behave

TABLE I

		T.1145	T. 23	T. 36	T. 17	Mean
Days from sowing to ear emergence	A	119·55	119·10	119·50	115·90	118·51
	B	118·90	120·25	119·50	115·80	118·61
	C	120·15	123·90	120·65	116·10	120·20
Grain yield per plant in grams	A	7·62	5·60	7·13	8·02	7·09
	B	10·13	5·72	9·52	10·15	8·88
	C	6·65	5·00	8·27	7·58	6·87
Number of panicles per plant	A	4·00	2·05	2·20	3·30	2·88
	B	4·70	2·25	2·70	3·50	3·28
	C	4·60	2·40	2·45	3·40	3·21
Length of panicle in cm.	A	18·40	27·02	23·26	21·32	22·50
	B	19·00	25·36	25·02	22·28	22·91
	C	18·00	22·94	24·04	21·96	21·73
Number of grains per panicle	A	90·30	112·16	98·16	96·92	99·38
	B	101·28	114·72	106·80	111·68	108·62
	C	71·52	100·16	107·84	92·18	92·92
Number of spikelets per panicle	A	107·90	138·22	123·32	115·80	121·31
	B	120·62	134·18	140·06	129·60	131·11
	C	87·88	127·92	130·46	111·88	114·53
Percentage of grains set per panicle	A	83·80	80·94	79·58	83·44	81·94
	B	84·26	85·64	76·26	86·64	83·20
	C	81·02	78·16	82·18	82·24	80·90
Weight of 1000 grains in grams	A	20·84	23·92	33·00	25·54	25·32
	B	21·32	22·06	33·08	25·58	25·51
	C	20·60	20·96	32·88	24·52	24·74

A—Control; B—Long day for 3 weeks in seed-bed to 1-week-old seedlings; C—Long day for 6 weeks in seed-bed to 1-week-old seedlings.

uniformly. The delay in the ear emergence as a result of long-day treatment for 6 weeks was pronounced only in the variety T. 23 whereas in the other 3 varieties the delay was not statistically significant. A significant higher grain yield was, however, obtained by long-day treatment for 3 weeks in all the varieties, mainly due to the increase in the number of panicles per plant and number of grains per panicle. The setting percentage and one thousand grain-weight were slightly different and did not contribute to the yield difference to any appreciable degree. The treatment for the longer duration of 6 weeks did not show any difference in grain yield from the controls.

The behaviour of these four early-winter varieties to long photoperiods is therefore different from two *aus* and two late-sown *aman* varieties of Bengal where Kar[1] and Sen[5] respectively obtained earliness. Misra[4] with similar long-day treatments as of the present investigation obtained slight earliness in the treatment for 3 weeks and considerable delay in treatment for 6 weeks with T. 3, T. 12 and T. 21, three medium-early varieties of rice of U.P. In other studies with two early varieties, T.N. 32 and T.N. 22 of U.P., Misra[2,3] obtained marked delay in ear emergence.

Thanks are due to Dr. Shri Ranjan, Allahabad, for his guidance and stimulating criticism throughout the work at the University Botanical Laboratories.

Dept. of Botany, GADADHAR MISRA.
Ravenshaw College,
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CHROMOSOME NUMBERS IN THE FAMILY COMBRETACEAE

THE family Combretaceæ is mainly tropical and subtropical in distribution. The members of the family are widely distributed in India. In Bengal, Prain[1] records the presence of twenty species belonging to seven genera.

The literature on the cytology of the family is very meagre. Simmonds[2] has recently reported the somatic number of chromosomes in *Terminalia catappa*, while Sen and Sen[3] have determined the meiotic and somatic number in *Quisqualis indica*.

The present study is confined to the following genera: *Terminalia, Combretum* and *Quisqualis*. The materials were obtained from plants growing in the college campus and from the Indian Botanical Garden, Sibpur.

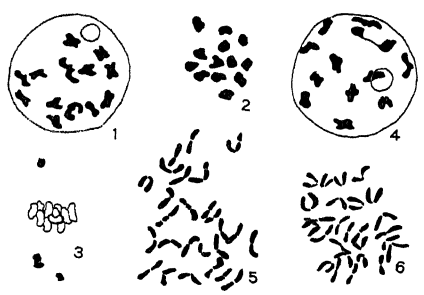
Root-tips, collected from seedlings for the study of somatic chromosomes were fixed in Lewitsky's chromic acid and formalin 1 : 1, and also in platinic chloride (1% aqueous) and formalin (10%) 1 : 1 and 1 : 1·5. The latter gave better results. For the study of meiosis flower buds were fixed in Nawashin's A & B and ·002 M oxyquinoline in the proportion of 1 : 1 : 1.[4]

The results of the investigation as also the previous determinations in the family are given in Table I.

TABLE I

Name of plant	Chromosome Nos.		Determined by
	n	$2n$	
Quisqualis indica	13	26	Sen, S. & Sen, N. K.
,,	13	26	Present author
Terminalia arjuna	13	26	,,
T. bellerica	13	26	,,
T. chebula	13	..	,,
T. catappa	..	24	Simmonds, N. W.
,,	13	..	Present author
Combretum gloriossum	22	..	,,

It will be seen from the above table that the basic number of chromosomes in *Terminalia* and *Quisqualis* appears to be 13. Simmonds, however, records $2n = 24$ for *T. catappa*; whereas the present author has observed the presence of 13 clear bivalents during diakinesis and metaphase I (Figs. 1 and 2) of dividing pollen mother cells. Simmond's work, therefore, requires corroboration before it can be accepted. The occurrence of 22 haploid chromosomes in *Combretum gloriossum* indicates that there may be more than one basic number of chromosomes in this family.



FIGS. 1-6

Figs. 1, 2 and 3 *Terminalia catappa*. Fig. 1. Diakinesis showing 13 clear bivalents; Fig. 2. Metaphase I, plate showing 13 bivalents; Fig. 3. Side view metaphase I, showing early separation and non-disjunction of bivalents; Fig. 4. *Terminalia bellerica*. Diakinesis showing 13 bivalents and inter-bivalent connection. Fig. 5. *Terminalia arjuna*. Somatic metaphase plate showing 26 chromosomes; Fig. 6. *T. bellerica*. Somatic metaphase plate showing 26 chromosomes. Figs. 1 to 4, ×1,250, Figs. 5 and 6, × 800.

Meiotic irregularities have been observed in *T. catappa* and *T. bellerica*, which will be dealt with in a separate paper, where a full account of the investigation will be presented.

My thanks are due to Dr. I. Banerji, under whose guidance the investigation is being carried on.

Dept. of Botany, SUBIR SEN.
Calcutta University,
July 2, 1955.

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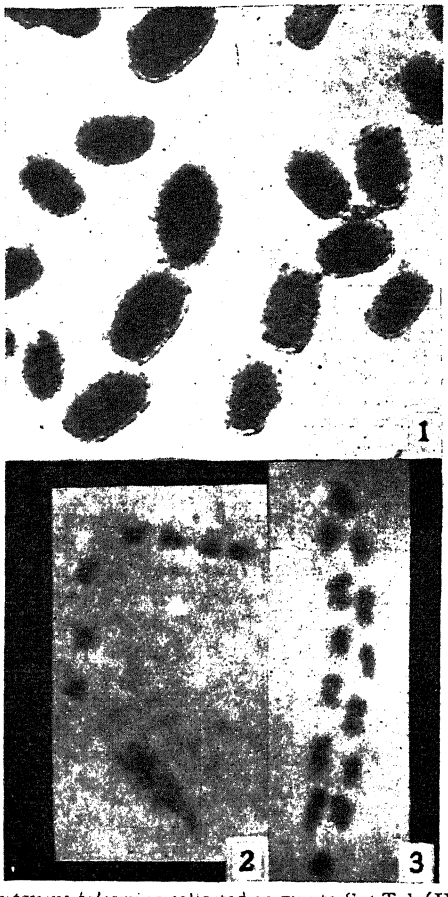
CYTOLOGY OF *IMPATIENS*

THE author noticed in North-West Himalayan species of the genus *Impatiens* that the pollen at shedding contains a big but faintly stainable tube nucleus and a deeply stainable crescent-shaped generative nucleus. At this stage aceto-carmine squash of the pollen grains reveals the generative nucleus in prometaphase from which the chromosomes can be easily counted. Generally the generative nucleus continues to remain in prometaphase even in the pollen of the pressed specimens from which also the chromosome number has been successfully determined by the author.[1] It may be mentioned that chromosome number has also been determined from a plant of *I. roylei* collected in 1900 from Pahalgam (Kashmir). It is not known how far this holds true for the rest of the genus. So far definite results have not been obtained with *I. holstii* Engl. & Warb.

Through the kindness of a number of friends it has been possible to have pressed material from many localities. Some of the Himalayan species have been sampled from almost their entire range. This increased the chances of discovery of any variations in meiosis or in chromosome number of pollen grains. The present observations are summarized below:

I. edgeworthii ($n = 6$) has the lowest chromosome number so far recorded for the genus. Many interesting irregularities have been noted in meiosis of pollen mother cells of *I. balsamina* and *I. scabrida*. *I. thomsoni* ($n = 7$ & 10) occurs in two cytological races. In this connection it is of interest to note that Blatter[2] has illustrated this species with two figures

which are morphologically distinguishable from each other.



Impatiens balsamina collected on way to Sat Tal (U.P.) in August, 1949.

FIG. 1. Haploid and Diploid pollen grains, × 325.

FIGS. 2–3. Generative nuclei in division showing 7 chromosomes in haploid grain (Fig. 2) and 14 chromosomes in diploid grain (Fig. 3). Note a faint tube nucleus on the lower side of Fig. 2, × 2,840.

Data compiled from the cytological work including the present investigation indicates that out of 340 species[3] belonging to this genus, only 23 have been cytologically worked out. One species has 6, ten have 7, four have 8 and eight have 10 chromosomes. Out of these, three species have been reported in more than one cytological race. These are *I. thomsoni* ($n = 7$ & 10), *I. roylei* ($n = 9$ & 10) and *I. parviflora* DC. ($n = 10$, 12 & 13). The over-all series is $n = 6$, 7, 8, 9, 10, 12 & 13. At present it is difficult to draw any conclusions about the basic number or numbers of this genus since it is unknown whether in the evolution of this genus there has taken place a phylogenetic reduction in chromosome number or its increase or both.

Species	Haploid chromosome number	Material*
I. edgeworthii Hook.	6	P.M.C., P.G. & H.S. $n = 5$, 6, 7
I. amphorata Edgew.	7	P.M.C., P.G. & H.S.
I. balfourii Hook.f.	7	P.G. & H.S.
I. balsamina Linn.	7	P.M.C., P.G. & H.S. $n = 7$, 11, 12, 13, 14
I. brachycentra Kar. and Kir.	7	P.G. & H.S.
I. scabrida DC.	7	P.M.C., P.G. & H.S. $n = 6$, 7, 8
I. platypetala Lindl. var. *aurentiaca*	7	H.S. (from Bogor, Indonesia)
I. species	7	do
I. thomsoni Hook.f.	7	P.M.C., P.G. & H.S.
	10	do
I. amplexicaulis Edgew.	10	P.G. & H.S.
I. biflora Walt.	10	H.S. (from Pennsylvania)
I. roylei Walp.	10	P.M.C., P.G. & H.S.
I. sulcata Wall. (*I. gigantea* Edgew)	10	do

* P.M.C.—Pollen mother cells, Fresh or fixed pollen grains. H.S.—Pollen grains from Herbarium sheets.

Furthermore it is not clear whether or not some of the higher numbers have been compounded by polyploidy involving forms with the lower chromosome numbers. A study of the karyotypes is in progress to know if this data can provide any clue for the probable trend.

The author is indebted to Prof. P. N. Mehra for his advice and encouragement, and to Mr. M. B. Raizada and Mr. D. Boomsma for their help. To Mr. R. S. Pathania he is thankful for taking the microphotographs illustrating this paper.

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GALL FORMATION IN THE ROOTS OF *ECLIPTA ALBA* LINN.

THE normal roots in *Eclipta alba* are smooth, cylindrical and white to yellowish brown but the roots infected by the nematode, *Heterodera marioni* remain short and exhibit local swellings or galls. These galls are spherical, spindle-shaped or tapering towards the tip. Round and tiny galls are scattered over the finely-branched rootlets. Sometimes three or four galls

are seated together to cause the root a twisted appearance. The galls measure from 1-6 mm. in diameter and 3-20 mm. in length. They are dotted with yellow or brown spots. In young seedlings the infected roots are associated with some brown viscid fluid at the dotted spots.

The normal root shows distinct epidermis, cortical parenchyma with air-spaces, and a central pentarch stele. In the infected root, the structure is considerably changed, the main changes being enlargement of endodermal cells, xylem vessels and xylem parenchyma even before the parasite enters, and they finally get attached to the vessels. In extreme cases the cavities produced by the nematode occupy the whole of the central stele and very few vascular elements remain. *Lippia nodiflora* retained in the stele a few xylem bundles whereas it was not so in the *Eclipta alba*. Experimentally infection with the nematode could be induced even without wounding the root system of these two hosts.

Thanks are due to Prof. M. Sayeduddin and Drs. M. A. Salam and M. R. Saxena for their valued advice.

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Osmania University,
Hyderabad-Dn., *April* 3, 1955.

CYTOLOGY OF CYATHEACEAE, WOODSIAE AND MARATTIACEAE

A cytological study of five members of Cyatheaceæ, three of Woodsiæ and one of Marattiaceæ has been made from acetocarmine squashes of the mother cells. The investigated species are *Cyathea spinulosa* Wall, *Hemitelia brunoniana* Cl., *Alsophila glauca* j. Sm., *A. oldhami* Bed. and *A. cf. Khasyana* Moore (Cyatheaceæ); *Dicalpe aspidioides* Blume, *Peranema cyatheoides* Don and *Woodsia elongata* Hook. (Woodsiæ), and *Angiopteris evecta* Hoffman (Marattiaceæ). These were collected from Darjeeling Himalayas.

The n chromosome for all the five members of Cyatheaceæ is 69. *Hemitelia brunoniana* has got remarkably small chromosomes which at diakinesis are almost round, while all the three species of *Alsophila* show larger chromosomes with X-, Y-, O- and V-shaped configurations (Fig. 1). The chromosomes of *Cyathea spinulosa* are intermediate in size between the two.

Because of the $n = 69$ in all the five members belonging to the three genera, *Cyathea, Hemitelia* and *Alsophila,* the cytological data would tend to support the suggestion of Holttum[1] and Copeland[2] in favour of submergence of the three genera into the single genus *Cyathea*. But the character of indusium (complete and inferior in *Cyathea*, incomplete and scale-like in *Hemitelia* and complete absence in *Alsophila*) cannot be easily brushed aside as a feature of little importance.

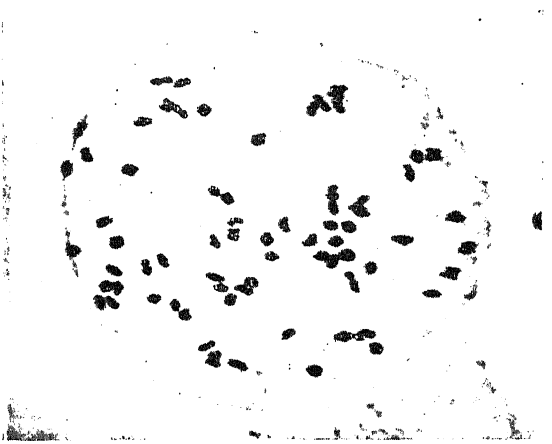


Fig. 1. *Alsophila oldhami*, $n = 69$.

All the three representatives of Woodsiæ, namely, *Dicalpe aspidioides, Peranema cyatheoides* and *Woodsia elongata* show 41 bivalents at diakinesis except *W. elongata* where in addition to $n = 41$, three mother cells with $n = 82$ have also been observed. This shows the monoploid number 41 in the alliance which suitably fits in with the 41 series characteristic of Dryopteroid ferns.[3] It may be concluded that Woodsiæ with $n = 41$ is correctly related to Dryopteroid ferns and its affinities with Cyatheaceæ having $n = 69$ appear to be obscure.

In *Angiopteris evecta* (Marattiaceæ) n is 40 while Manton and Sledge (*loc. cit.*) have recorded a tetraploid form of *A. evecta* from Ceylon with $n = 80$.

The meiosis is normal in all the members investigated. A fuller report appears elsewhere.

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EGG-LAYING AND FEEDING BEHAVIOUR OF SUGARCANE HISPA *ASAMANGULIA CUSPIDATA* MAULIK

HISPID beetles (which are leaf-miners in their young stages) have been recorded as common pests on economic crops such as sugarcane, rice, *Sorghum*, etc. While studying the egg-laying and feeding behaviour of these insects, Issac[1] observed that the eggs of the sugarcane hispa were inserted into leaf-tissues, and although a large number of grubs hatched out from these eggs, only one survived and devoured the mesophyll alone, leaving the upper and lower layers of epidermis entirely free. Gupta[2] has described the nature of attack of the sugarcane hispa but has not specified the exact nature of the tissues fed upon by the grub. In the case of the rice hispa, *Hispa armigera* Oliv., Ayyar[3] has stated that the eggs are inserted into the tissues of young leaves close to their tips. On hatching, the grub burrows into the tissues and feeding upon the green matter produces the characteristic blister-patch at the tip of an infested leaf. Recently De and Konar,[4] while describing the nature of attack of the *Jowar* hispid, *Dactylispa albopilosa* Gestro, have mentioned that it feeds voraciously on the tissues between the two epidermal layers of the lamina and finally pupates within, as in the case of all the other species mentioned above. The present note seeks to adduce evidence to show where exactly this pest lays its eggs and what tissues it feeds upon.

From an examination of the transverse section of a sugarcane leaf wherein the hispa has laid eggs, it is evident that the tissues inside the leaf are intact, showing a rupture more or less in the middle in the longitudinal plane only. The insects inserts its ovipositor to rupture the lower epidermis and makes a longitudinal slit in the lamina wherein eggs are laid in clusters which may contain as many as 11 eggs. The portion naturally becomes raised. On hatching, only one grub apparently survives and feeds on the softer tissues consisting of mesophyll, the chlorophyll-bearing ring of cells outside the larger vascular sheaths and the vascular bundles not protected by sclerenchymatous cells. It mostly confines its activity along the lower epidermis, thus, leaving the tissues of the larger vascular bundles intact (Fig. 1), the sheaths of which are hard and evidently not nutritious like the soft parenchymatous chlorophyll-containing cells. The hard upper layers appear thus to give the insect protection from unfavourable conditions such as strong insolation and the resultant heat, as also from its enemies.



FIG. 1. T.S. of sugarcane lamina showing a portion of vascular bundle under higher magnification, × 100.

The authors are grateful to Sri. K. L. Khanna, for affording facilities and encouragement, and to Sri. S. L. Sharma for going through the manuscript.

Central Sugarcane Research Station, Pusa (Bihar), *September* 6, 1955.

V. G. PRASAD.
S. B. TRIAR.

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EINSTEINIUM AND FERMIUM

TWO new words, *einsteinium* and *fermium*, were used for elements No. 99 and 100 by A. Ghiorso (U.S.) in a discussion of the chemistry of heavy elements at the recent International Conference on the Peaceful Uses of Atomic Energy. Both elements were first discovered in debris from the October 1952 H-bomb explosion by G. Seaborg. Both einsteinium, symbol E, and fermium, symbol Fm, have since been formed in the University of California cyclotron and in nuclear reactors at Argonne National Laboratory and Los Alamos, N.M. All discovered elements through No. 101, mendelevium, have now been named.

REVIEWS

Optical Glassworking. By T. Twyman. (Hilger and Watts Publication), 1955. Pp. viii + 275. Price 24 *sh.*

The book is an abridged edition of the author's "Prism and Lens Making" published for technicians actually engaged in the manufacture of optical components. Written, as it is, by a world authority on this subject, its value as a guide for workers in this field is immense. Being more concise than the original, it forms a convenient book of reference on the optical work bench.

Optical technology is a living subject advancing rapidly into engineering proportions. Techniques not only in attaining higher precision, but also in large-scale production, are making rapid strides in the manufacture of optical components. For a person engaged in this line of work, periodical publications of this type, will keep him abreast of the latest developments in technique, without his being obliged to constantly refer to journals, which have not only multiplied in number, but also in the volume of new material published in them. The latter are of interest only to research workers and directors of optical operations. Twyman has done well in omitting such portions from the abridged book. Topics like theories of grinding and polishing, manufacturing processes for abrasives, process layouts in optical workshops, prescription of spectacle lenses, general theories of microscope objectives, latest developments on production of aspherical surfaces, recent advances in microscopy like U-V microscope, phase-contrast microscope, etc., are all either omitted or abridged without sacrificing the essentials of optical technology.

Principles and practice of methods of inspection of plane and spherical surfaces by interference phenomena are described in a manner just enough for the routine technician, who is not bothered about definitions, tolerances and plane parallelism. The chapter on the constitution and properties of dioptic substances is completely omitted and the subject of testing of raw optical glass abridged to suitable proportions. The first chapter containing historical matter running to 16 pages could as well have been omitted thus further reducing the bulk and price of the book.

With all the non-essentials omitted in the abridged edition, the value of this book as one for reference is not very much diminished. To one who is interested in the principles of optical manufacturing technique, it makes pleasant reading. To the routine technician the book is indispensable. Even to the expert in this line, there is much to study and learn.

I. RAMAKRISHNA RAO.

The Quantitative Analysis of Drugs. By D. C. Garrat. (Chapman & Hall), 1955. Pp. xv + 670. Price 70 *sh.* net.

The first edition of this book was published in the year 1937 under the title "Drugs and Galenicals: Their Quantitative Analysis". The book was then cordially welcomed in the field of pharmacy and particularly by those who were concerned with drug analysis. Since the publication of the first edition there has been considerable development in the field of medicinal chemistry and a second and enlarged edition of the book was long due and its publication, therefore, is most opportune.

Though the title of the book has been changed slightly, the format and the subject-matter have not been materially altered. As in the first edition, the monographs are alphabetically arranged and consist of methods for quantitative determinations of the various pharmacopœial and non-pharmacopœial substances and their salts and preparations. Besides these, there are chapters on oils, fats and waxes, essential oils, physical methods, appendices, supplement and a general index.

From a careful survey of the book it appears that the author has taken pains in bringing the subject-matters uptodate and has made substantial improvements on his first edition by supplementing additional useful materials, such as monographs on vitamins, antibiotics, steroids, sulphonamides, etc. Some of the old monographs have been deleted and others have also been rewritten. Newer analytical techniques have been incorporated wherever necessary. Additional methods outside those in official pharmacopœias have been given from the author's personal experience of analytical work of many years' standing. These will serve as test checks. A few examples taken at random will show the help that analysts may derive from such alternative assay procedures. Thus, the titration method suggested in the case of thiouracil is very simple, the modifica-

tion proposed in the assay of Liq. Ext. of Nux Vomica might help to avoid emulsions which cause great difficulty in the course of assay of the drug by B.P. method, the colorimetric method for the determination of small quantities of Jaborandi alkaloids may be very advantageous, and the volumetric methods, other than the B.P. method, furnished in the book might be useful for the assay of hydrogen peroxide as these are not influenced by the presence of organic preservatives. The modification of B.P.C. method for the estimation of hydrocyanic acid is worth noting and the colorimetric methods for the assay of digitalis glycosides might help to keep a check on their biological assay results. Mention may also be made of the colour tests furnished for cannabis which have been claimed to be more consistent than tests on animals and assessment by trained smokers.

Inclusion of a section on the general application of physical methods dealing with light absorption methods, electrometric titrations, emission spectrography, flame photometry, polarography, etc., is timely and of interest, since the application of physical methods is specially advantageous because of their specificity, speed of operation and sensitivity. Moreover, these methods are extremely helpful when only very small quantities of the sample are available. Appendices concerning the determination of extraneous matter in food and drugs and titration in non-aqueous solvents are additional improvements. The inclusion of references at the end of each monograph has been very helpful.

The book will be an essential guide and inidspensable companion to all drug analysts, pharmaceutical chemists, public and toxicological analysts and others engaged in the same line.

B. MUKERJI.

Chemistry of Carbon Compounds, Vol. III, Part A. (*Aromatic Compounds.*) Edited by E. H. Rodd. Pp. xxiv + 686. Price not given.

The first two volumes of this important series are well known. They relate to aliphatic compounds and alicyclic compounds respectively. Volume III is devoted to aromatic compounds, and Part A deals with the chemistry of benzene and simpler benzene derivatives. It starts with a valuable introductory chapter containing an historical account of the development of the theories of aromatic structure from the time of Kekule to the present day, of the theory of mesmorism and of substitution in the benzene ring. About thirty years ago when the electronic theory of valency was applied to organic chemistry, the study of benzenoid compounds played the most important part. Professor Ingold, whose name has been intimately connected with these studies, has given a critical account of the various ideas which have been advanced for a clear understanding of the behaviour of aromatic compounds. Appropriate to the present state of knowledge, adequate treatment has been given in this chapter of homolytic aromatic substitution by Hey and Williams. In the succeeding chapters has been presented well established information about the different classes of aromatic compounds such as monocyclic benzenoid hydrocarbons and their simpler derivatives, halogen and nitro compounds, amines and their important derivatives, including diazo and azo compounds, phenols, alcohols, aldehydes, ketones and carboxylic acids. Chapter VI on nitrogen derivatives of aniline is the biggest running over hundred and thirty pages, and it contains a wealth of information on various aspects of the chemistry of diazo and allied compounds, including recent references on the Meerwein reaction.

The treatment of the chemistry of the simpler benzene derivatives paves the way for the study of complex type and multicyclic compounds which will be the subject-matter of Part B. The ten chapters of the present Part A are well-proportioned and constitute an important addition to the literature of organic chemistry.

T. R. SESHADRI.

Blood Coagulation and Thrombosis. (*British Medical Bulletin*, Vol. 11, No. 1.) (Published by the Medical Department, British Council, London), 1955. Pp. 1-82. Price 15 *sh.*

The introduction of anti-coagulant therapy for thrombosis has given an impetus to research in many fundamental aspects of blood coagulations. This sudden spurt of activity in various parts of the world has brought forth a flood of new facts, a re-assessment of old theories and a sense of confusion due to the lack of definition in the techniques and terminologies used. Biggs, in the opening chapter, has tried to bring order by a clear exposition of the coagulation factors and a discussion on the techniques involved in clotting. The involvement of inherited conditions and possible acquired deficiencies with recent advances in the diagnosis and treatment of Hæmophilia and the nature of circulating anticoagulants which interfere with

the early stages thromboplastin formation have been presented by Pitney *et al.* and Hougie. Ackroyd summarises the role of platelets in coagulation, thrombosis and hæmostasis and the results of their dysfunction as also the causes and effects of platelet lysis or agglutination. The hypothesis of mural thrombus being an important factor in the pathogenesis of arteriosclerosis has been revived by Duguid. Recent advances in the chemistry and mode of action of coumarin, heparin and related compounds with a comprehensive account of anticoagulant therapy comprise an important section of this monograph. Large-scale separation and purification of non-cellular components of the cellular mechanism involving fibrinogen, prothrombin and thrombin have been described by Kekwick. A historical survey of the subject of blood coagulation and thrombosis emphasizing the paucity of our knowledge and the need to reorient our concepts is ably presented by Robb Smith in the concluding chapter.

This monograph maintains the usual standard of reviews presented occasionally by the British Council, and will be found useful both by clinicians and research workers in this field of haematology.

M. Sirsi.

Surgery of the Heart and Thoracic Blood Vessels. (*British Medical Bulletin*, Vol. 11, No. 3.) (Published by the Medical Department, British Council, London), 1955. Pp. 171-242. Price 15 *sh.*

Surgery of the heart owes such a lot to the great advances in anæsthesia that it is fitting that the symposium should begin with an excellent chapter on "Anæsthesia for Cardiac Surgery" by Brown and Sellick. The more recent developments such as hypothermia and its practical applications, cross-circulation technique, the use of artificial heart-lung mechanisms are all dealt with in four splendid sections.

The development and application of cardiac surgery is impossible without the co-operation of the cardiologists, and there are two very good articles on the selection of patients for surgery in congenital and acquired heart disease by M. Campbell and P. Wood respectively. The surgery of patent ductus arteriosus and of coarctation of the aorta are dealt with in a lucid manner by O. S. Tubbs, himself a pioneer in the surgery of congenital heart disease. C. G. Rob and Eastcott with their almost unrivalled experience in vessel-grafting have added a very good chapter on "Arterial Reconstruction, with special reference to Homografts". Cardiac distress and arrest, of such paramount importance in surgery of the heart, are dealt with ably in a separate article.

Excellent articles by eminent authors and authorities like Sir Russell Brock, T. Holmes Sellers and others on operations for congenital heart disease, on treatment of pulmonary stenosis, on surgery of the aortic valve, of septal defects, of mitral stenosis, and on problems in the surgical treatment of vulvular incompetence complete this volume.

Surgeons in general, and thoracic surgeons in particular, will be very grateful to Sir Russell Brock, the Chairman of the Committee that planned the symposium, N. R. Barrett, the scientific editor and the other authors, for this well illustrated and valuable contribution to the subject.

U. Mohan Rau.

The Nucleic Acids—Chemistry and Biology, Vols. 1 & 2. Edited by E. Chargaff and J. N. Davidson. (Academic Press), 1955. Vol. 1: Pp. xi + 692. Price $ 16.80; Vol. 2: Pp. xi + 576. Price $ 14.50.

The two volumes on nucleic acids which have appeared recently, constitute the most exhaustive treatment available on the chemistry and biology of nucleic acids.

(*i*) In Volume I, emphasis is laid on the chemistry and methodology of nucleic acids. After a brief but illuminating introductory chapter by the editors, the chemistry of the hydrolysis products of nucleic acids are dealt with in Chapters 2-4.

In Chapter 2, Overend and Stacey give a detailed account of the chemistry of ribose and deoxyribose. In his article on the chemistry of purines and pyrimidines, Aaron Bendich has drawn pointed attention to the different systems of nomenclature used. The occurrence and distribution, general properties and newer developments for the synthesis of pyrimidines and purines using isotopes are also included. The chemistry of nucleosides and nucleotides has been ably reviewed by J. Baddiley. Of special interest to biochemists is the exhaustive treatment of the chemistry of the nucleotide enzymes.

The separation and estimation of nucleic acid components are detailed in Chapters 5-9. Detailed procedures for the hydrolysis of nucleic acids and spectrophotometric estimations of the purine and pyrimidine fractions are given by

H.. S. Loring. W. E. Coben has contributed a chapter on the separation of nucleic acid derivatives by ion-exchange chromotography. Wyatt's article on paper chromatographic separation of nucleic acid components includes general technique, detection of purine and pyrimidine derivatives on filter-paper, quantitative estimation of the nitrogenous components of nucleic acids and chromatography of nucleic acid sugars. A cogent summary of the theory of electrophoretic separation of nucleic acid components and a description of the apparatus and techniques employed are given by Smith. In Chapter 9 Dische described colour reactions of nucleic acid components. Chargaff has presented an excellent review on the isolation and composition of a desoxypentose nucleic acids and of the corresponding nucleoproteins. The methods for the structural investigation of these compounds are also given. The modern methods of isolation and determination of the composition of the pentose nucleic acids and of the corresponding nucleoproteins have been discussed by Magasanik. Brown and Todd have adequately organised and presented with remarkable clarity, the comparatively modern work which has played a dominant role in the elucidation of the internucleotidic linkages present in both ribonucleic acids and desoxyribonucleic acids. The physical properties of nucleic acids including structural determination by X-ray diffraction and dissociation constants are described in Chapter 13 by Jordan. The next chapter by Beaven, Holiday and Johnson relates to the optical porperties of nucleic acids and their components.

In the last chapter of this volume, Schmidt deals with the enzymes attacking nucleic acid components. After a detailed discussion of the properties of nucleases, some data concerning the intracellular distribution of enzymes of nucleic acid metabolism are given.

Some minor errors, mostly typographical, were detected. On page 106, the structural formula termed 4-amino-5-imidazole carboxamide is not correct. The structural formulæ of uridine and cystine on page 139 seem to be in error. On page 274 in the last line some letters are missing.

(*ii*) Volume II of nucleic acids opens with a chapter by Leslie wherein a general survey of the nucleic acid content of tissues and cells is made. In this chapter a distant biological bias is discernible. A description of various cytochemical techniques for nucleic acids which have paved the way for a recognition of the intimate association of nucleic acids with genes and chromosomes is given by Hewson Swift. Dounce has presented a critical review of the various methods for the isolation of cell nuclei and nucleoli and for the determination of the chemical composition of the cell nucleus. A chapter on the desoxyribonucleic acid content of the nucleus by Vendrely is also included. In the article on nucleic acids in chromosomes and mitotic division, Bo Thorell has discussed the main results obtained by biochemical and cytological studies of the chromosomal nucleic acids and their behaviour during mitosis. A short description of the methods employed is given at the beginning of each section. The review on the cytoplasm by Hogeboom and Schneider is a competent presentation wherein they discuss the uses and limitations of cytochemical techniques. An authoritative account of the biochemical properties and the enzymic make-up of the isolated cell structures, given in this review is notable for its critical outlook. This is followed by four chapters on the biosynthesis of pentose, the purines and pyrimidines, the nucleosides and nucleotides and the nucleic acids, each of them being a masterpiece of exposition. Smellie has given a highly informative discussion of the metabolic activity and catabolism of the nucleic acids and the use of labelled nitrogen, carbon and phosphorus compounds in these studies. The closing chapters on the biological role of desoxypentose nucleic acids and pentose nucleic acids constitute a fitting finale to this useful volume.

The reviewer is particularly struck by the extensive biblography and wealth of experimental details which have been packed in these two volumes as well as by the critical approach made by the various authors, who have made notable contributions in the respective fields under discussion. This enterprise, a truly monumental one, deserves praise, and investigators on nucleic acids should be greatly indebted to the numerous individual authors for their painstaking labour.

K. V. GIRI

Abnormal and Pathological Plant Growth—A Symposium. Edited by A. H. Sparrow, Chairman, Symposium Committee. (Brookhaven Symposia in Biology No. 6, Biology Department, Brooklyn National Laboratory, Upton, New York), 1953. Pp. vii + 303. Price $ 2.10.

There seems little doubt that this subject is one of the most fertile fields of biological enquiry and has grown, in recent years, into a colossus from very small and obscure beginnings. Of course, many types

SCIENCE NOTES AND NEWS

l Rot of Sugarcane on Lamina

K. Singh and G. Sharma, Central Sugar- e Research Station, Pusa, Bihar, observed aves of sugarcane black dots in dry straw- ed patch which were contiguous with red esions on mid-ribs of Co 453 in July- st 1955. These, on microscopic examina- ı, proved to be acervuli, and gave typical tures of *Physalospora tucumanensis* Speg. is is the first report of the fungus appear- on leaf-lamina.

ocumentation of Molecular Spectroscopy

The publication of a new system of docu- enting infra-red and Raman spectra is nounced jointly by Butterworths Scientific blications (88, Kingsway, London, W.C. 2) Verlag Chemie, Weinheim/Bergstrasse, many. The spectra of pure compounds, and other technological products, will be pro- ded on punched cards, with much other uctural and spectral information. A detailed de which applies to the punched holes has en designed so that the cards can be used provide answers to a wide variety of ques- ıs which often occur in research. The spec- l cards are also linked to a current litera- e survey, which adds to their intrinsic value. tails of the scheme which is expected to in in 1956 with about two thousand cards ıually, can be obtained from the publishers.

r. D. V. Bal

Dr D. V. Bal, Professor of Zoology, Institute ience, Bombay, has been nominated by CO as a member of the International visory Committee on Marine Sciences. He rticipated in the meeting of this Committee eld at Tokyo on the 24th and 25th October 955 preceded by a Symposium on Physical ce: ography.

8th Annual Report of the Bose Institute

The Thirty-Eighth Anniversary Meeting of ıe Bose Institute was celebrated on November)th, when Dr. Sunder Lal Hora, Director of ological Survey of India, delivered the 17th charya Jagadish Chandra Memorial Lecture. e chose as his subject "Conflict *vs.* Co-opera- on as Factors in Evolution".

The Director, Dr. M. M. Bose, in his report or the past year, observed that the Institute had submitted to the Central Government, plans and estimates for expansion of the activities of the Institute during the Second Five-Year Plan. All the plants for expansion of the research activities of the Institute depended on the provision of additional buildings for laboratory accommodation.

Reference was also made to the international co-operative work to be undertaken for the International Geophysical Year, 1958, in connection with which the Bose Institute proposes to make continuous record of intensities of different components of the cosmic rays with apparatus installed in the Mayapuri Research Station, Darjeeling.

New High Temperature Thermocouple

A new thermocouple suitable for measuring temperature in the range 1,700-1,880° C. represents a most important advance in high temperature pyrometry. This is made of rhodium-platinum alloy wires of 20 and 40% rhodium content respectively. Above 1,700° C. they give e.m.f's exceeding 4 millivolts, enabling a relatively robust and inexpensive indicating instrument to be used. The alloy can, moreover, be worked in the cold and this greatly minimises contamination during manufacture of the wires. (*Metal Industry*, September 9, 1955.)

Poliomyelitis Virus Crystallised

The University of California has announced that Dr. C. E. Schmerdt and Dr. F. L. Schaffer, of the University Virus Laboratory, have succeeded in crystallising a purified poliomyelitis virus. This is the first time a human or animal infecting virus has been crystallised.

Crystallisation of the virus is being regarded as an important step in determining the physical and chemical properties of virus disease agents.

Canadian Atomic Reactor for India

The Government of India have accepted the Canadian offer for an NRX atomic reactor under the Colombo Plan. This type of reactor is a high-powered research and experimental unit of the kind now in operation at the Canadian Atomic Energy Establishment at Chalk River. The Government of India is prepared to allow accredited foreign scientists, including those from other Colombo Plan countries in South

and South-East Asia, to use the facilities that will be available at the atomic energy centre in India.

The Institution of Telecommunication Engineers

The first series of the Studentship and Graduateship Examinations of the Institution of Telecommunication Engineers will commence on Monday, the 21st May 1956, and will continue on each succeeding days (including holidays) except Sundays. The examinations will generally be held at Bangalore, Bombay, Calcutta, Delhi, Jabalpur, Madras and Poona.

The last date for the receipt of applications is January 31st, 1956. Application forms can be had from: The Institution of Telecommunication Engineers, Post Box No. 481, New Delhi.

Regulations and syllabus for the examinations have been printed in the June 1955 issue of the *Journal of the Institution of Telecommunication Engineers*, but copies are separately available, each annas 8 (in stamps).

The Graduateship Examination of the Institution of Telecommunication Engineers offers a unique opportunity to professional men who have not had the benefit of academic training in Telecommunication Engineering at the University level. The Studentship Examinations are designed for trade apprentices who have had no formal schooling.

Titanium Purification by Zone Refining

The Westinghouse Research Laboratories have devised a method of purifyinv titanium and other hard-to-get metals by imprisoning the molten metal inside a cage of its own making. The process, called cage zone refining, uses a unique method to melt a bar of metal while the metal acts as its own crucible, thus preventing contamination by any containing vessel. The object of the process is to prepare super-pure metals.

In zone refining, a bar is melted progressively from one end to the other. The new technique applies this refining process to metals which are so active at high temperatures that they react with any crucible in which they can be heated.

The success of the method depends upon the fact that most impurities in metals have a preference for either the liquid or solid state of the metal. Iron, a common impurity in titanium, has a preference for the liquid state of titanium. When a bar of impure titanium is melted progressively from end to end, tl concentrates in the liquid titanium and the molten zone to the end of the bar end is then cut off and discarded leavi rest of the titanium bar purer.

Effect of Ionizing Radiation on Haemc and Cytochrome

Findings that throw considerable lig the nature of the oxygen effect in mo some of the effects of ionizing radiati living systems are reported by H. Laser University of Cambridge in *Nature* (195 361). The change produced in hæmc depended on its initial oxidized or r state, and was independent of the prese oxygen. That is, irradiated hæmoglobi comes oxidized (presumably by hy radicals), whereas methemoglobin be reduced (presumably hydrogen atoms).

Like hæmoglobin, ferrocytochrome bc oxidized whether irradiated in air or in gen. Ferricytochrome becomes reduced irradiated in nitrogen, but anomalously not affected at all when irradiated in doses up to 35 kiloroentgens.

The catalytic activity of succinic oxi by cytochrome c was reduced by only after receiving 35 kiloroentgens in air. Tde dose in nitrogen caused a 35% loss of vity, apparently because the initial re product undergoes a secondary and irreve oxidation to a green pigment after oxyg admitted.

Award of Research Degree

The Andhra University has awarded D.Sc. Degree in Geology to Shri U. Asw narayana for his thesis entitled "Radio-Ac of Some Indian Rocks, Sea-Floor Sedi and Minerals".

The Ph.D. Degree of Osmania Universit been awarded to the following scholars i subject mentioned against their na Shri Garikapathy Sivarama Sastry—Ph Shri S. Balakrishna—Geology, and Shri Moorthy—Chemical Technology.

The University of Poona has awarded Ph.D. Degree in Biochemistry to Shri Phansalkar for his thesis entitled, "Studi Protein Metabolism with Special Referen Utilization of Animal and Vegetable Portei Human Subjects".

1523-55. Printed at The Bangalore Press, Bangalore City, by C. Vasudeva Rao, Superintendent, and Published by A. V. Telang, M.A., for the Current Science Association, Bangalore.
Editor: Prof. G. N. Ramachandran, A. C. College of Technology, Madras 25.

of stimuli such as physical, biological and chemical on cell response have not only fascinated the pathologist and the physiologist but also the geneticist. In any rapid-moving field of enquiry it is but natural to find oneself utterly lost unless the benefit of summarising the over-all progress is made available by stimulating symposia on the subject for those actively engaged in the field. This objective is admirably fulfilled by this timely publication.

Substances influencing the growth and differentiation of plants, cell enlargement, cell division, inhibition of root and bud growth appear to depend not only on enzyme and co-enzyme systems but on nucleic acids with an induction and pre-induction phase. There is also evidence of the participation of purines in cell enlargement. Indeed, it has been possible to grow mature plants, in the vascular cryptogams, from pieces of stem apices with or without leaf primordia. It is found that most amino acids except arginine inhibit growth but alanine, aspartic and glutamic acids encourage growth. Again, there are what are called genetic tumours initiated independent of pathological entities, be they bacterial, virus or insect, and these have been successfully demonstrated in many hybrid combinations of *Nicotiana* and appear to be found on diploid and polyploid plants whose genotypes result as a combination of genomes of two species when there was at least one complete genome of each parent species present in the hybrid. Electron microscope studies have been reported on wound-tumour viruses indicating identical form in the host plant and insect vector. The effects of virus in cells on organs already formed and in cells on organs undergoing morphogenesis are adequately described.

It is clear from the symposium that the future lines of study are to be mainly directed towards a complete understanding of the fundamental metabolic processes of plant cells with special emphasis on the causes affecting the synthesis and destruction of the naturally occurring auxins. As a means to an end, this excellently produced symposium number with select bibliography and good editing will go a long way to enthuse the specialist to greater efforts in penetrating the 'why' of abnormality in tissues. I warmly commend this book to all researchers in border-line sciences.

T. S. SADASIVAN.

Chronica Botanica, Vol. 14, No. 3. (*Plant Genera —A Symposium.*) (The Chronica Botanica Co., Waltham, Mass., U.S.A.), 1953. Pp. 92-160. Price $ 2.00.

This little reprint summarising the symposium on plant genera headed by the distinguished G. H. M. Lawrence, Irwing W. Bailey and Arthur J. Eames and four other eminent workers in different fields presents the subject in tabloid form. There are many significant statements made by the various specialists, some of which are summarised below.

As serious taxonomic work requires considerable time for adequate field, laboratory and herbarium studies, support for such work must be envisaged on a long-term basis, and as the plant kingdom is large enough to provide ample opportunities for all interested in studying its diversified members, nationalistic bias must not be a bar to consideration and evaluation of all literature on the subject. Likewise we must not restrict our knowledge to papers published in languages employing only Roman alphabets. It is necessary for the taxonomist to let the morphologist, cytogeneticist and others know of his needs, to propose specific problems for investigation, and to indicate a readiness to assist in any way possible and this could be done through botanical journals and there is considerable gain to be had from the pooling of the efforts of several specialists. The conscious or subconscious assumption that a single sample of an organ or tissue affords reliable criteria for the anatomical characterization of a species or genus clearly is untenable. It is felt that a co-ordinated cytogenetic and morphological study would provide the proper basis for problems of re-classification as constancy of chromosome numbers within a genus provides a valuable test for the inclusion or exclusion of a particular species where doubt exists. Those who feel that chromosome number and chromosome morphology are more important than similar evidences from comparable features of the plant in evolutionary and taxonomic studies are indeed making an unwarranted assumption. For, cytogenetic approaches will not provide the broad general outlines of classification within a genus, nor is it expected that given genera will always be sharply delimited by the use of cytogenetic criteria alone.

I commend this little document to the taxonomist for careful study of the pros and cons of a particular existing system of classification of Angiosperms, to begin with, prior to embarking on any major changes based on his or her

own limited observations. However, it must be added that biochemical data on the behaviour of genera and species would appear as useful a criterion as a genetical-*cum*-morphological approach which has been stressed by the authors of this symposium. It is gratifying to see that most plant virus workers are thinking in these terms even in a group that has very much less to contribute towards morphological studies.

T. S. SADASIVAN.

Books Received

The Foreseeable Future. By Sir George Thomson. (Cambridge University Press), 1955. Pp. vii + 166. Price 10 *sh.* 6 *d.*

Contributions to Plant Anatomy, Vol. 15. By Irving W. Bailey. (Waltham, Mass: The Chronica Botanica; Agra, Banwarilal Jain), 1955. Pp. xxiv + 262. Price $ 7.50.

Recent Progress in Hormone Research, Vol. XI. Edited by Gregory Pincus. (Academic Press), 1955. Pp. v + 518. Price $ 10.00.

High Vacuum Technique. By J. Yarwood. (Chapman & Hall), 1955. Pp. viii + 208. Price 21 *sh.*

Some Extinct Elephants, Their Relatives and the Two Living Species. By P. E. P. Deraniyagala. (Ceylon National Museums, Colombo), 1955. Pp. 161. Price Rs. 6.

PHYSICS IN ENGINEERING AND TECHNOLOGY

THE physicist discovers scientific principles and invents devices to describe and explain them. The technician applies and magnifies these devices for human convenience and comfort. There is no branch of engineering or technology in which one or other physical principle is not applied on a scale never contemplated by the discoverer. Faraday, at the time of his discovery of electromagnetic induction, did not visualise the modern developments in electrical production. The initial investigations on radioactivity by the British and French scientists were never with a view to develop atomic energy. It took 40 years for this immense energy, conserved in matter, to be practically liberated after the original postulate of Einstein of the equivalence of matter and energy.

Instances, without number, can be given of applications of simple physical principles, demonstrated and developed in the beginning on a laboratory scale, to large-scale engineering in a variety of branches of modern civilization.

Though specialisation in one branch of science or technology has become the order of the day, in view of the vast developments in each branch by itself, a knowledge on the part of the technician of the fundamentals of physics and its varied applications is essential for a proper understanding of the specialised role he is playing in the complicated scientific and industrial advances of the modern age. Such a basic, but comprehensive knowledge, is imparted by this book of Harris and Hummerling.

Reading through the book, one appreciates the importance of physics both as a science and in its technological applications. Each chapter begins with enunciation and explanation of the fundamentals of each aspect of physics and ends with a clear exposition of their applications in present-day engineering and technology. Principles of mechanics, heat, sound, light, magnetism, electricity, electronics and atomic physics are presented in a lucid manner, and the variety of modern developments, in which these principles are utilised, described in a style capable of being understood even by the beginner in technological studies.

Precision tools embodying mechanical principles, hydraulic machines based upon principles of hydrostatics and dynamics, laws of motion as applied to the latest gears and gear systems, centrifugal forces and their role in modern transport systems, thermodynamical principles and their practical application in internal combustion engines and in heating and other types of air conditioning systems are all described in semi-popular language. The chapters devoted to sound reveal how this subject, which was till recently a dead science, is brought back to life in its varied applications in the acoustics of buildings, magnetic and mechanical recording, geophysical exploration, sound on film records, etc. Electrical machines as developed on fundamental physical principles are dealt with elaborately.

The authors have attempted to make the book thorough. In doing so, however, they have shown their bias for thermal and electrical engineering aspects at the sacrifice of optical technology, which is not treated with the importance it deserves. Excepting for this, the book is a wonderful guide for technicians of intermediate grade. The summaries, the examples worked out and the questions set at the end of all chapters enable the reader to assess his understanding of the subjects. Illustrations are copiously given for all aspects of applied physics, and add considerably to the value of the book.

I. RAMAKRISHNA RAO.

* *Introductory Applied Physics*, by Norman C. Harris and Edwin M. Hemmerling. (Mcgraw Hill),1955. pp. viii + 297, Price $ 6.75.

and South-East Asia, to use the facilities that will be available at the atomic energy centre in India.

The Institution of Telecommunication Engineers

The first series of the Studentship and Graduateship Examinations of the Institution of Telecommunication Engineers will commence on Monday, the 21st May 1956, and will continue on each succeeding days (including holidays) except Sundays. The examinations will generally be held at Bangalore, Bombay, Calcutta, Delhi, Jabalpur, Madras and Poona.

The last date for the receipt of applications is January 31st, 1956. Application forms can be had from: The Institution of Telecommunication Engineers, Post Box No. 481, New Delhi.

Regulations and syllabus for the examinations have been printed in the June 1955 issue of the *Journal of the Institution of Telecommunication Engineers*, but copies are separately available, each annas 8 (in stamps).

The Graduateship Examination of the Institution of Telecommunication Engineers offers a unique opportunity to professional men who have not had the benefit of academic training in Telecommunication Engineering at the University level. The Studentship Examinations are designed for trade apprentices who have had no formal schooling.

Titanium Purification by Zone Refining

The Westinghouse Research Laboratories have devised a method of purifyinv titanium and other hard-to-get metals by imprisoning the molten metal inside a cage of its own making. The process, called cage zone refining, uses a unique method to melt a bar of metal while the metal acts as its own crucible, thus preventing contamination by any containing vessel. The object of the process is to prepare super-pure metals.

In zone refining, a bar is melted progressively from one end to the other. The new technique applies this refining process to metals which are so active at high temperatures that they react with any crucible in which they can be heated.

The success of the method depends upon the fact that most impurities in metals have a preference for either the liquid or solid state of the metal. Iron, a common impurity in titanium, has a preference for the liquid state of titanium. When a bar of impure titanium is melted progressively from end to end, concentrates in the liquid titanium an the molten zone to the end of the end is then cut off and discarded le rest of the titanium bar purer.

Effect of Ionizing Radiation on Hae and Cytochrome

Findings that throw considerable the nature of the oxygen effect in some of the effects of ionizing radi living systems are reported by H. Las University of Cambridge in *Nature* (361). The change produced in ha depended on its initial oxidized or state, and was independent of the pr oxygen. That is, irradiated hæmogl comes oxidized (presumably by radicals), whereas methemoglobin reduced (presumably hydrogen atom

Like hæmoglobin, ferrocytochrome oxidized whether irradiated in air or gen. Ferricytochrome becomes reduc irradiated in nitrogen, but anomalo not affected at all when irradiated doses up to 35 kiloroentgens.

The catalytic activity of succinic by cytochrome c was reduced by o after receiving 35 kiloroentgens in air. dose in nitrogen caused a 35% loss vity, apparently because the initial product undergoes a secondary and irr oxidation to a green pigment after o admitted.

Award of Research Degree

The Andhra University has awar D.Sc. Degree in Geology to Shri U. narayana for his thesis entitled "Radio of Some Indian Rocks, Sea-Floor S and Minerals".

The Ph.D. Degree of Osmania Unive been awarded to the following scholar subject mentioned against their Shri Garikapathy Sivarama Sastry— Shri S. Balakrishna—Geology, and Sh Moorthy—Chemical Technology.

The University of Poona has awa Ph.D. Degree in Biochemistry to Sh Phansalkar for his thesis entitled, "St Protein Metabolism with Special Refe Utilization of Animal and Vegetable Po Human Subjects".

1523-55. Printed at The Bangalore Press, Bangalore City, by C. Vasudeva Rao, Superintendent, an Published by A. V. Telang, M.A., for the Current Science Association, Bangalore.
Editor: Prof. G. N. Ramachandran, A. C. College of Technology, Madras 25.

of stimuli such as physical, biological and chemical on cell response have not only fascinated the pathologist and the physiologist but also the geneticist. In any rapid-moving field of enquiry it is but natural to find oneself utterly lost unless the benefit of summarising the over-all progress is made available by stimulating symposia on the subject for those actively engaged in the field. This objective is admirably fulfilled by this timely publication.

Substances influencing the growth and differentiation of plants, cell enlargement, cell division, inhibition of root and bud growth appear to depend not only on enzyme and co-enzyme systems but on nucleic acids with an induction and pre-induction phase. There is also evidence of the participation of purines in cell enlargement. Indeed, it has been possible to grow mature plants, in the vascular cryptogams, from pieces of stem apices with or without leaf primordia. It is found that most amino acids except arginine inhibit growth but alanine, aspartic and glutamic acids encourage growth. Again, there are what are called genetic tumours initiated independent of pathological entities, be they bacterial, virus or insect, and these have been successfully demonstrated in many hybrid combinations of *Nicotiana* and appear to be found on diploid and polyploid plants whose genotypes result as a combination of genomes of two species when there was at least one complete genome of each parent species present in the hybrid. Electron microscope studies have been reported on wound-tumour viruses indicating identical form in the host plant and insect vector. The effects of virus in cells on organs already formed and in cells on organs undergoing morphogenesis are adequately described.

It is clear from the symposium that the future lines of study are to be mainly directed towards a complete understanding of the fundamental metabolic processes of plant cells with special emphasis on the causes affecting the synthesis and destruction of the naturally occurring auxins. As a means to an end, this excellently produced symposium number with select bibliography and good editing will go a long way to enthuse the specialist to greater efforts in penetrating the 'why' of abnormality in tissues. I warmly commend this book to all researchers in border-line sciences.

T. S. SADASIVAN.

Chronica Botanica, Vol. 14, No. 3. (*Plant Genera —A Symposium.*) (The Chronica Botanica Co., Waltham, Mass., U.S.A.), 1953. Pp. 92-160. Price $ 2.00.

This little reprint summarising the symposium on plant genera headed by the distinguished G. H. M. Lawrence, Irwing W. Bailey and Arthur J. Eames and four other eminent workers in different fields presents the subject in tabloid form. There are many significant statements made by the various specialists, some of which are summarised below.

As serious taxonomic work requires considerable time for adequate field, laboratory and herbarium studies, support for such work must be envisaged on a long-term basis, and as the plant kingdom is large enough to provide ample opportunities for all interested in studying its diversified members, nationalistic bias must not be a bar to consideration and evaluation of all literature on the subject. Likewise we must not restrict our knowledge to papers published in languages employing only Roman alphabets. It is necessary for the taxonomist to let the morphologist, cytogeneticist and others know of his needs, to propose specific problems for investigation, and to indicate a readiness to assist in any way possible and this could be done through botanical journals and there is considerable gain to be had from the pooling of the efforts of several specialists. The conscious or subconscious assumption that a single sample of an organ or tissue affords reliable criteria for the anatomical characterization of a species or genus clearly is untenable. It is felt that a co-ordinated cytogenetic and morphological study would provide the proper basis for problems of re-classification as constancy of chromosome numbers within a genus provides a valuable test for the inclusion or exclusion of a particular species where doubt exists. Those who feel that chromosome number and chromosome morphology are more important than similar evidences from comparable features of the plant in evolutionary and taxonomic studies are indeed making an unwarranted assumption. For, cytogenetic approaches will not provide the broad general outlines of classification within a genus, nor is it expected that given genera will always be sharply delimited by the use of cytogenetic criteria alone.

I commend this little document to the taxonomist for careful study of the pros and cons of a particular existing system of classification of Angiosperms, to begin with, prior to embarking on any major changes based on his or her

H. S. Loring. W. E. Coben has contributed a chapter on the separation of nucleic acid derivatives by ion-exchange chromotography. Wyatt's article on paper chromatographic separation of nucleic acid components includes general technique, detection of purine and pyrimidine derivatives on filter-paper, quantitative estimation of the nitrogenous components of nucleic acids and chromatography of nucleic acid sugars. A cogent summary of the theory of electrophoretic separation of nucleic acid components and a description of the apparatus and techniques employed are given by Smith. In Chapter 9 Dische described colour reactions of nucleic acid components. Chargaff has presented an excellent review on the isolation and composition of a desoxypentose nucleic acids and of the corresponding nucleoproteins. The methods for the structural investigation of these compounds are also given. The modern methods of isolation and determination of the composition of the pentose nucleic acids and of the corresponding nucleoproteins have been discussed by Magasanik. Brown and Todd have adequately organised and presented with remarkable clarity, the comparatively modern work which has played a dominant role in the elucidation of the internucleotidic linkages present in both ribonucleic acids and desoxyribonucleic acids. The physical properties of nucleic acids including structural determination by X-ray diffraction and dissociation constants are described in Chapter 13 by Jordan. The next chapter by Beaven, Holiday and Johnson relates to the optical porperties of nucleic acids and their components.

In the last chapter of this volume, Schmidt deals with the enzymes attacking nucleic acid components. After a detailed discussion of the properties of nucleases, some data concerning the intracellular distribution of enzymes of nucleic acid metabolism are given.

Some minor errors, mostly typographical, were detected. On page 106, the structural formula termed 4-amino-5-imidazole carboxamide is not correct. The structural formulæ of uridine and cystine on page 139 seem to be in error. On page 274 in the last line some letters are missing.

(*ii*) Volume II of nucleic acids opens with a chapter by Leslie wherein a general survey of the nucleic acid content of tissues and cells is made. In this chapter a distant biological bias is discernible. A description of various cytochemical techniques for nucleic acids which have paved the way for a recognition of the intimate association of nucleic acids with genes and chromosomes is given by Hewson Swift. Dounce has presented a critical review of the various methods for the isolation of cell nuclei and nucleoli and for the determination of the chemical composition of the cell nucleus. A chapter on the desoxyribonucleic acid content of the nucleus by Vendrely is also included. In the article on nucleic acids in chromosomes and mitotic division, Bo Thorell has discussed the main results obtained by biochemical and cytological studies of the chromosomal nucleic acids and their behaviour during mitosis. A short description of the methods employed is given at the beginning of each section. The review on the cytoplasm by Hogeboom and Schneider is a competent presentation wherein they discuss the uses and limitations of cytochemical techniques. An authoritative account of the biochemical properties and the enzymic make-up of the isolated cell structures, given in this review is notable for its critical outlook. This is followed by four chapters on the biosynthesis of pentose, the purines and pyrimidines, the nucleosides and nucleotides and the nucleic acids, each of them being a masterpiece of exposition. Smellie has given a highly informative discussion of the metabolic activity and catabolism of the nucleic acids and the use of labelled nitrogen, carbon and phosphorus compounds in these studies. The closing chapters on the biological role of desoxypentose nucleic acids and pentose nucleic acids constitute a fitting finale to this useful volume.

The reviewer is particularly struck by the extensive biblography and wealth of experimental details which have been packed in these two volumes as well as by the critical approach made by the various authors, who have made notable contributions in the respective fields under discussion. This enterprise, a truly monumental one, deserves praise, and investigators on nucleic acids should be greatly indebted to the numerous individual authors for their painstaking labour.

K. V. GIRI

Abnormal and Pathological Plant Growth—A Symposium. Edited by A. H. Sparrow, Chairman, Symposium Committee. (Brookhaven Symposia in Biology No. 6, Biology Department, Brooklyn National Laboratory, Upton, New York), 1953. Pp. vii + 303. Price $ 2.10.

There seems little doubt that this subject is one of the most fertile fields of biological enquiry and has grown, in recent years, into a colossus from very small and obscure beginnings. Of course, many types

SCIENCE NOTES AND NEWS

l Rot of Sugarcane on Lamina

K. Singh and G. Sharma, Central Sugar- e Research Station, Pusa, Bihar, observed aves of sugarcane black dots in dry straw- ed patch which were contiguous with red esions on mid-ribs of Co 453 in July- st 1955. These, on microscopic examina- ı, proved to be acervuli, and gave typical tures of *Physalospora tucumanensis* Speg. is is the first report of the fungus appear- on leaf-lamina.

ocumentation of Molecular Spectroscopy

The publication of a new system of docu- enting infra-red and Raman spectra is nounced jointly by Butterworths Scientific blications (88, Kingsway, London, W.C. 2) Verlag Chemie, Weinheim/Bergstrasse, many. The spectra of pure compounds, and other technological products, will be pro- ded on punched cards, with much other uctural and spectral information. A detailed de which applies to the punched holes has en designed so that the cards can be used provide answers to a wide variety of ques- ıs which often occur in research. The spec- l cards are also linked to a current litera- e survey, which adds to their intrinsic value. tails of the scheme which is expected to in in 1956 with about two thousand cards ıually, can be obtained from the publishers.

r. D. V. Bal

Dr D. V. Bal, Professor of Zoology, Institute ience, Bombay, has been nominated by CO as a member of the International visory Committee on Marine Sciences. He rticipated in the meeting of this Committee ld at Tokyo on the 24th and 25th October 55 preceded by a Symposium on Physical ce: ography.

8th Annual Report of the Bose Institute

The Thirty-Eighth Anniversary Meeting of ıe Bose Institute was celebrated on November)th, when Dr. Sunder Lal Hora, Director of ological Survey of India, delivered the 17th charya Jagadish Chandra Memorial Lecture. e chose as his subject "Conflict *vs.* Co-opera- on as Factors in Evolution".

The Director, Dr. M. M. Bose, in his report or the past year, observed that the Institute had submitted to the Central Government, plans and estimates for expansion of the activities of the Institute during the Second Five-Year Plan. All the plants for expansion of the research activities of the Institute depended on the provision of additional buildings for laboratory accommodation.

Reference was also made to the international co-operative work to be undertaken for the International Geophysical Year, 1958, in connection with which the Bose Institute proposes to make continuous record of intensities of different components of the cosmic rays with apparatus installed in the Mayapuri Research Station, Darjeeling.

New High Temperature Thermocouple

A new thermocouple suitable for measuring temperature in the range 1,700-1,880° C. represents a most important advance in high temperature pyrometry. This is made of rhodium-platinum alloy wires of 20 and 40% rhodium content respectively. Above 1,700° C. they give e.m.f's exceeding 4 millivolts, enabling a relatively robust and inexpensive indicating instrument to be used. The alloy can, moreover, be worked in the cold and this greatly minimises contamination during manufacture of the wires. (*Metal Industry*, September 9, 1955.)

Poliomyelitis Virus Crystallised

The University of California has announced that Dr. C. E. Schmerdt and Dr. F. L. Schaffer, of the University Virus Laboratory, have succeeded in crystallising a purified poliomyelitis virus. This is the first time a human or animal infecting virus has been crystallised.

Crystallisation of the virus is being regarded as an important step in determining the physical and chemical properties of virus disease agents.

Canadian Atomic Reactor for India

The Government of India have accepted the Canadian offer for an NRX atomic reactor under the Colombo Plan. This type of reactor is a high-powered research and experimental unit of the kind now in operation at the Canadian Atomic Energy Establishment at Chalk River. The Government of India is prepared to allow accredited foreign scientists, including those from other Colombo Plan countries in South

tion proposed in the assay of Liq. Ext. of Nux Vomica might help to avoid emulsions which cause great difficulty in the course of assay of the drug by B.P. method, the colorimetric method for the determination of small quantities of Jaborandi alkaloids may be very advantageous, and the volumetric methods, other than the B.P. method, furnished in the book might be useful for the assay of hydrogen peroxide as these are not influenced by the presence of organic preservatives. The modification of B.P.C. method for the estimation of hydrocyanic acid is worth noting and the colorimetric methods for the assay of digitalis glycosides might help to keep a check on their biological assay results. Mention may also be made of the colour tests furnished for cannabis which have been claimed to be more consistent than tests on animals and assessment by trained smokers.

Inclusion of a section on the general application of physical methods dealing with light absorption methods, electrometric titrations, emission spectrography, flame photometry, polarography, etc., is timely and of interest, since the application of physical methods is specially advantageous because of their specificity, speed of operation and sensitivity. Moreover, these methods are extremely helpful when only very small quantities of the sample are available. Appendices concerning the determination of extraneous matter in food and drugs and titration in non-aqueous solvents are additional improvements. The inclusion of references at the end of each monograph has been very helpful.

The book will be an essential guide and inidspensable companion to all drug analysts, pharmaceutical chemists, public and toxicological analysts and others engaged in the same line.

B. MUKERJI.

Chemistry of Carbon Compounds, Vol. III, Part A. (*Aromatic Compounds.*) Edited by E. H. Rodd. Pp. xxiv + 686. Price not given.

The first two volumes of this important series are well known. They relate to aliphatic compounds and alicyclic compounds respectively. Volume III is devoted to aromatic compounds, and Part A deals with the chemistry of benzene and simpler benzene derivatives. It starts with a valuable introductory chapter containing an historical account of the development of the theories of aromatic structure from the time of Kekule to the present day, of the theory of mesmorism and of substitution in the benzene ring. About thirty years ago when th electronic theory of valency was applied t organic chemistry, the study of benzenoid com pounds played the most important part. Pro fessor Ingold, whose name has been intimatel connected with these studies, has given a crit cal account of the various ideas which hav been advanced for a clear understanding c the behaviour of aromatic compounds. Appro priate to the present state of knowledge, ade quate treatment has been given in this chapt of homolytic aromatic substitution by Hey an Williams. In the succeeding chapters has bee presented well established information abou the different classes of aromatic compound such as monocyclic benzenoid hydrocarbons an their simpler derivatives, halogen and nitr compounds, amines and their important der vatives, including diazo and azo compound phenols, alcohols, aldehydes, ketones and car boxylic acids. Chapter VI on nitrogen deriva tives of aniline is the biggest running ove hundred and thirty pages, and it contains wealth of information on various aspects of th chemistry of diazo and allied compounds, in cluding recent references on the Meerwein re action.

The treatment of the chemistry of the sim pler benzene derivatives paves the way for th study of complex type and multicyclic com pounds which will be the subject-matter c Part B. The ten chapters of the present Part are well-proportioned and constitute an im portant addition to the literature of organi chemistry.

T. R. SESHADRI.

Blood Coagulation and Thrombosis. (*Britis Medical Bulletin*, Vol. 11, No. 1.) (Publishe by the Medical Department, British Counci London), 1955. Pp. 1-82. Price 15 *sh.*

The introduction of anti-coagulant therap for thrombosis has given an impetus to researc in many fundamental aspects of blood coagu lations. This sudden spurt of activity in variou parts of the world has brought forth a flood c new facts, a re-assessment of old theories an a sense of confusion due to the lack of defini tion in the techniques and terminologies usec Biggs, in the opening chapter, has tried to brin order by a clear exposition of the coagulatio factors and a discussion on the techniques in volved in clotting. The involvement of inherite conditions and possible acquired deficiencie with recent advances in the diagnosis and treat ment of Hæmophilia and the nature of cir culating anticoagulants which interfere wit

the early stages thromboplastin formation have been presented by Pitney *et al.* and Hougie. Ackroyd summarises the role of platelets in coagulation, thrombosis and hæmostasis and the results of their dysfunction as also the causes and effects of platelet lysis or agglutination. The hypothesis of mural thrombus being an important factor in the pathogenesis of arteriosclerosis has been revived by Duguid. Recent advances in the chemistry and mode of action of coumarin, heparin and related compounds with a comprehensive account of anticoagulant therapy comprise an important section of this monograph. Large-scale separation and purification of non-cellular components of the cellular mechanism involving fibrinogen, prothrombin and thrombin have been described by Kekwick. A historical survey of the subject of blood coagulation and thrombosis emphasizing the paucity of our knowledge and the need to reorient our concepts is ably presented by Robb Smith in the concluding chapter.

This monograph maintains the usual standard of reviews presented occasionally by the British Council, and will be found useful both by clinicians and research workers in this field of hæmatology.

M. SIRSI.

Surgery of the Heart and Thoracic Blood Vessels. (*British Medical Bulletin*, Vol. 11, No. 3.) (Published by the Medical Department, British Council, London), 1955. Pp. 171-242. Price 15 *sh.*

Surgery of the heart owes such a lot to the great advances in anæsthesia that it is fitting that the symposium should begin with an excellent chapter on "Anæsthesia for Cardiac Surgery" by Brown and Sellick. The more recent developments such as hypothermia and its practical applications, cross-circulation technique, the use of artificial heart-lung mechanisms are all dealt with in four splendid sections.

The development and application of cardiac surgery is impossible without the co-operation of the cardiologists, and there are two very good articles on the selection of patients for surgery in congenital and acquired heart disease by M. Campbell and P. Wood respectively. The surgery of patent ductus arteriosus and of coarctation of the aorta are dealt with in a lucid manner by O. S. Tubbs, himself a pioneer in the surgery of congenital heart disease. C. G. Rob and Eastcott with their almost unrivalled experience in vessel-grafting have added a very good chapter on "Arterial Reconstruction, with special reference to Homografts". Cardiac distress and arrest, of such paramount importance in surgery of the heart, are dealt with ably in a separate article.

Excellent articles by eminent authors and authorities like Sir Russell Brock, T. Holmes Sellers and others on operations for congenital heart disease, on treatment of pulmonary stenosis, on surgery of the aortic valve, of septal defects, of mitral stenosis, and on problems in the surgical treatment of vulvular incompetence complete this volume.

Surgeons in general, and thoracic surgeons in particular, will be very grateful to Sir Russell Brock, the Chairman of the Committee that planned the symposium, N. R. Barrett, the scientific editor and the other authors, for this well illustrated and valuable contribution to the subject.

U. MOHAN RAU.

The Nucleic Acids—Chemistry and Biology, Vols. 1 & 2. Edited by E. Chargaff and J. N. Davidson. (Academic Press), 1955. Vol. 1: Pp. xi + 692. Price $ 16.80; Vol. 2: Pp. xi + 576. Price $ 14.50.

The two volumes on nucleic acids which have appeared recently, constitute the most exhaustive treatment available on the chemistry and biology of nucleic acids.

(*i*) In Volume I, emphasis is laid on the chemistry and methodology of nucleic acids. After a brief but illuminating introductory chapter by the editors, the chemistry of the hydrolysis products of nucleic acids are dealt with in Chapters 2-4.

In Chapter 2, Overend and Stacey give a detailed account of the chemistry of ribose and deoxyribose. In his article on the chemistry of purines and pyrimidines, Aaron Bendich has drawn pointed attention to the different systems of nomenclature used. The occurrence and distribution, general properties and newer developments for the synthesis of pyrimidines and purines using isotopes are also included. The chemistry of nucleosides and nucleotides has been ably reviewed by J. Baddiley. Of special interest to biochemists is the exhaustive treatment of the chemistry of the nucleotide enzymes.

The separation and estimation of nucleic acid components are detailed in Chapters 5-9. Detailed procedures for the hydrolysis of nucleic acids and spectrophotometric estimations of the purine and pyrimidine fractions are given by

My thanks are due to Professor R. V. Seshaiya for guidance, and to the Government of India for the award of a senior research scholarship.

Dept. of Zoology, (Miss) V. R. Meenakshi.
Annamalai University,
September 1, 1955.

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THE FOOD OF HORSE-MACKEREL *CARANX*

The Horse-Mackerel known as *Parai* in Tamil ranks high among the food fishes in and outside Madras City, and constitutes an important fishery. Chacko[1] has studied the feeding habits of *Caranx hippos* and *Caranx sansun* and found that they feed mainly on teleostean food such as *Leiognathus* sp. and *Stolephorous* sp. Much work has to be done regarding the food of Horse-Mackerels. One hundred and twenty-eight specimens of *Caranx djedaba* were examined from September 1953 to May 1955. This species enters Madras waters about September of each year and migrates elsewhere in May. The data collected show that this fish uses the Madras area as feeding ground and breeds elsewhere.

Except 16 fishes, all had food in the stomach. It is significant to note that these fishes feed less during the immature stages than when they are mature. Table I, based on 128 fishes, illustrates this fact.

Table I

Showing the condition of feed and the length of the fishes examined during the mature and immature stages

Length of fishes / Condition of feed	10–14 cm.		15–20 cm.		21–25 cm.	
	(*a*)	(*b*)	(*a*)	(*b*)	(*a*)	(*b*)
Empty	2	3	3	6	..	2
Little	1	4	2	7	..	4
¼	..	7	1	8	1	3
½	9	2	4	2	..	5
¾	7	1	8	2	7	..
Full	8	2	10	..	4	3

(*a*) Mature; (*b*) Immature.

The stomach contents were analysed and measurued and the data obtained are given in Table II.

From Table II it will be clear that this fish is carnivorous and that crustacea form the main item of food. Since *Squilla* sp., *Acetes* sp., *Penœus indicus*, cumacea, megalopa, zœa stages of crab and mysis form the chief constituents it may be inferred that this fish is actively predacious and feeds in midwater zones. Of the Entomostraca, only the copepods *Euterpina* sp. and *Acartia* sp. were identified. Apart from this there were also unidentifiable appendages and other remains of crustacea. The teleosteans were observed to form a minor part of the diet when compared with the quantity of crustacea that the fish had consumed. Fish eggs, scales, pectoral girdle, parts of anal fin were also found in the stomach. Species of Clupeidæ and Engraulidæ were the most frequent teleostei on which the fish feeds. Only rarely polychætes occurred in the stomach and it was in the month of October, December and April. Since the polychætes are digested very easily and only setæ are left, no specific identification could be made. Whenever polychætes

Table II

Showing the average volume of food and also the percentage average of the various food items of Caranx djedaba

Particulars	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May
Vol. of stomach content in c.c.	0·5	0·3	0·4	0·3	0·4	0·5	0·5	0·5	0·3
Crustacean item	69·5	92·0	82·6	80·0	77·4	88·9	73·3	71·1	79·5
Teleostean item	25·5	4·1	15·7	15·4	17·5	10·1	12·8	21·5	15·3
Polychætes	..	2·6	..	1·3	..	..	..	3·3	..
Sand particles	..	1·3	..	1·2	..	..	..	1·9	..
Other food items	5·0	..	1·7	2·1	5·1	..	13·9	2·2	5·2

resent small quantities of sand parti-
re also found in the stomach. It is
e that these are derived from the poly-
The amount of vegetable stuff the
l on was very little. Only very small
s of algæ and diatoms were found, and
were usually in an advanced state of
n—only Coscinodiscus could be identi-

crustacea form 79·2% of its diet, it is
probable that this species does not des-
e young ones of *Leiognathus* and *Stole-*
s to the extent that Chacko[1] has re-
The teleostean food item forms only
of the total volume of the stomach con-
Of this, Clupeids form a considerable
ion. No Carangids were identified.
re it may be concluded that the differ-
n the data presented by Chacko and the
author may be due to the different loca-
rom which the fish were caught.
ks are due to Prof. C. P. Gnanamuthu
dance and encouragement.

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ING HABITS OF FRESH-WATER ISHES OF UTTAR PRADESH

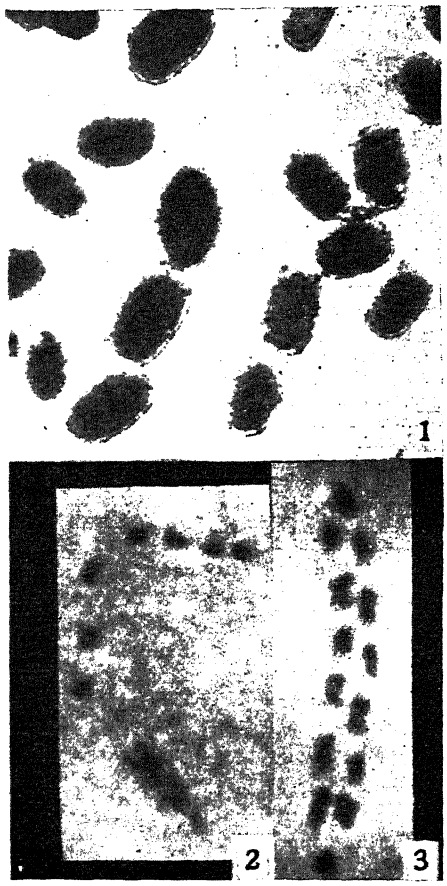
studying the food of the adult fishes of Pradesh during 1953-55 it was observed shes have definite affinities to particular levels according to their specific foods, e fauna and flora present at these levels. ssociations were also observed earlier by rjee, Sen Gupta and Roy Chowdhury[1] in ., and Misra[2] in three species of carps ., but to our knowledge this is the first t to survey the food affinities of a major- food fishes of U.P.

kly fish hauls were made in local tanks nds during 1953-55. Fishes belonging to -seven species and of different size- were obtained. These were brought to oratory where they were identified, mea- and weighed. The date, time and locality hauls were noted. The abdomen was opened and the fishes fixed in 8-10% in for later investigations. The stomach ne intestine were carefully removed and pen and the contents washed with water a petri-dish. The material was next ned and counted under the low and high powers of the microscope on a counting slide. The percentage composition of the gut contents was estimated by the latest method followed by Hynes.[3]

Of the fishes examined, the food of the following eight species, *viz.*, *Gadusia chapra* (Ham.), *Ailia coila* (Ham.), *Catla catla* (Ham.), *Ambassis nama* (Ham.), *Ambassis ranga* (Ham.), *Glossogobius giuris* (Ham.), *Callichrous pabda* Ham., and *Oxygaster bacaila* Ham., consisted of desmids (*Closterium, Cosmarium*), diatoms (*Cyclotella, Nitzchia, Synedra*), plankton algæ (*Volvox, Gonium, Phacus, Eudorina, Pandorina, Nostoc, Oscillitoria, Gleotrichia, Microcystis, Spirogyra* and *Ulothrix*), plankton rotifers (*Rotifer, Rattulus*), plankton crustaceans and their larvæ (*Bosmina, Daphnia, Ceriodaphnia* and *Cyclops*), as well as pelagic insects and their larvæ. Job[4] concluded that *Therapon jerbua* was a surface-feeder due to the presence of insect larvæ and adult mosquitoes in its stomach contents. Similarly Mookerjee *et al.*,[1] held that fishes living at the surface feed on crustacea and algæ, whereas the fishes which feed on rotten plants, sand and mud are bottom-feeders. We have however recovered many more types of surface or planktonic food organisms from the gut contents of the fishes listed above and conclude therefore that they are surface feeders. These fishes include both omnivorous and carnivorous forms.

The following nine species of food fishes, *viz.*, *Labeo rohita* (Ham.), *Labeo bata* (Ham.), *Amblypharyngodon mola* (Ham.), *Mystus seenghala* (Sykes), *Mystus vittatus* (Bloch.), *Mystus cavasius* (Ham.), *Mastacembelus armatus* (Lacep.), *Wallago attu* (Bl. & Schn.), and *Xenentodon cancilla* (Ham.), had a food-content of algæ, aquatic plants, adult crustaceans (shrimps), insects and their larvæ (water-bugs, mayflies, damselflies), fish (carp fingerlings and cyprinids), fish scales and sometimes sand and mud particles. These fishes are neither purely surface-feeders nor purely bottom-feeders, since the food organisms recovered from their gut-contents are distributed more in the middle layer of the waters than in the surface or bottom layers. These fishes may occasionally come up near the surface or go down to the bottom in search of their food, but in the main they are mid-feeders. We therefore conclude that the above-mentioned species are mid-feeders since they feed essentially on sub-surface food organisms. They contain both herbivorous and carnivorous forms.

which are morphologically distinguishable from each other.



Impatiens balsamina collected on way to Sat Tal (U.P.) in August, 1949.

FIG. 1. Haploid and Diploid pollen grains, × 325.

FIGS. 2–3. Generative nuclei in division showing 7 chromosomes in haploid grain (Fig. 2) and 14 chromosomes in diploid grain (Fig. 3). Note a faint tube nucleus on the lower side of Fig. 2, × 2,840.

Data compiled from the cytological work including the present investigation indicates that out of 340 species[3] belonging to this genus, only 23 have been cytologically worked out. One species has 6, ten have 7, four have 8 and eight have 10 chromosomes. Out of these, three species have been reported in more than one cytological race. These are *I. thomsoni* ($n = 7$ & 10), *I. roylei* ($n = 9$ & 10) and *I. parviflora* DC. ($n = 10$, 12 & 13). The over-all series is $n = 6$, 7, 8, 9, 10, 12 & 13. At present it is difficult to draw any conclusions about the basic number or numbers of this genus since it is unknown whether in the evolution of this genus there has taken place a phylogenetic reduction in chromosome number or its increase or both.

Species	Haploid chromosome number	Material*
I. edgeworthii Hook.	6	P.M.C., P.G. & H.S. $n = 5$, 6, 7
I. amphorata Edgew.	7	P.M.C., P.G. & H.S.
I. balfourii Hook.f.	7	P.G. & H.S.
I. balsamina Linn.	7	P.M.C., P.G. & H.S. $n = 7$, 11, 12, 13, 14
I. brachycentra Kar. and Kir.	7	P.G. & H.S.
I. scabrida DC.	7	P.M.C., P.G. & H.S. $n = 6$, 7, 8
I. plotypetala Lindl. var. *aurentiaca*	7	H.S. (from Bogor, Indonesia)
I. species	7	do
I. thomsoni Hook.f.	7	P.M.C., P.G. & H.S.
	10	do
I. amplexicaulis Edgew.	10	P.G. & H.S.
I. biflora Walt.	10	H.S. (from Pennsylvania)
I. roylei Walp.	10	P.M.C., P.G. & H.S.
I. sulcata Wall. (*I. gigantea* Edgew)	10	do

* P.M.C.—Pollen mother cells, Fresh or fixed pollen grains. H.S.—Pollen grains from Herbarium sheets.

Furthermore it is not clear whether or not some of the higher numbers have been compounded by polyploidy involving forms with the lower chromosome numbers. A study of the karyotypes is in progress to know if this data can provide any clue for the probable trend.

The author is indebted to Prof. P. N. Mehra for his advice and encouragement, and to Mr. M. B. Raizada and Mr. D. Boomsma for their help. To Mr. R. S. Pathania he is thankful for taking the microphotographs illustrating this paper.

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GALL FORMATION IN THE ROOTS OF *ECLIPTA ALBA* LINN.

THE normal roots in *Eclipta alba* are smooth, cylindrical and white to yellowish brown but the roots infected by the nematode, *Heterodera marioni* remain short and exhibit local swellings or galls. These galls are spherical, spindle-shaped or tapering towards the tip. Round and tiny galls are scattered over the finely-branched rootlets. Sometimes three or four galls

:e seated together to cause the root a twisted ppearance. The galls measure from 1-6 mm. diameter and 3-20 mm. in length. They are)tted with yellow or brown spots. In young edlings the infected roots are associated with me brown viscid fluid at the dotted spots. The normal root shows distinct epidermis, rtical parenchyma with air-spaces, and a cen- al pentarch stele. In the infected root, the ructure is considerably changed, the main anges being enlargement of endodermal cells, ylem vessels and xylem parenchyma even be- re the parasite enters, and they finally get tached to the vessels. In extreme cases the vities produced by the nematode occupy the hole of the central stele and very few vascu- r elements remain. *Lippia nodiflora* retained the stele a few xylem bundles whereas it as not so in the *Eclipta alba*. Experimentally fection with the nematode could be induced ren without wounding the root system of these vo hosts.

Thanks are due to Prof. M. Sayeduddin and rs. M. A. Salam and M. R. Saxena for their dued advice.

ept. of Botany, (Miss) Q. Siddiqui.
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CYTOLOGY OF CYATHEACEAE, WOODSIAE AND MARATTIACEAE

Cytological study of five members of Cya- neaceæ, three of Woodsiæ and one of Maratti- ceæ has been made from acetocarmine squashes f the mother cells. The investigated species re *Cyathea spinulosa* Wall, *Hemitelia brunoniana* Cl., *Alsophila glauca* j. Sm., *A. oldhami* ed. and *A. cf. Khasyana* Moore (Cyatheaceæ); *Dicalpe aspidioides* Blume, *Peranema cyatheoides* Don and *Woodsia elongata* Hook. Woodsiæ), and *Angiopteris evecta* Hoffman Marattiaceæ). These were collected from Darjeeling Himalayas.

The n chromosome for all the five members f Cyatheaceæ is 69. *Hemitelia brunoniana* has ot remarkably small chromosomes which at akinesis are almost round, while all the three pecies of *Alsophila* show larger chromosomes ith X-, Y-, O- and V-shaped configurations Fig. 1). The chromosomes of *Cyathea spinulosa* are intermediate in size between the two. Because of the $n = 69$ in all the five members elonging to the three genera, *Cyathea, Hemitelia* nd *Alsophila*, the cytological data would tend o support the suggestion of Holttum[1] and Copeland[2] in favour of submergence of the three genera into the single genus *Cyathea*. But the character of indusium (complete and inferior in *Cyathea*, incomplete and scale-like in *Hemitelia* and complete absence in *Alsophila*) cannot be easily brushed aside as a feature of little importance.

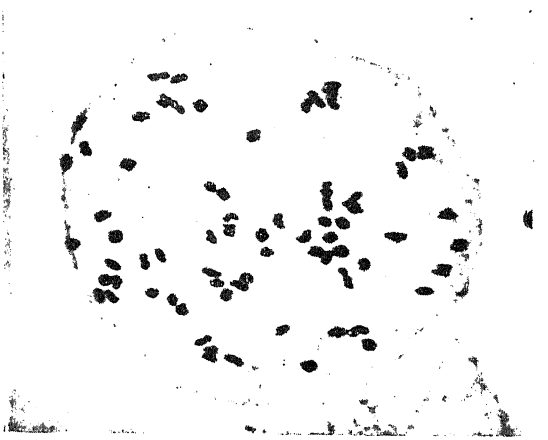


Fig. 1. *Alsophila oldhami*, $n = 69$.

All the three representatives of Woodsiæ, namely, *Dicalpe aspidioides, Peranema cyatheoides* and *Woodsia elongata* show 41 bivalents at diakinesis except *W. elongata* where in addition to $n = 41$, three mother cells with $n = 82$ have also been observed. This shows the monoploid number 41 in the alliance which suitably fits in with the 41 series characteristic of Dryopteroid ferns.[3] It may be concluded that Woodsiæ with $n = 41$ is correctly related to Dryopteroid ferns and its affinities with Cyatheaceæ having $n = 69$ appear to be obscure.

In *Angiopteris evecta* (Marattiaceæ) n is 40 while Manton and Sledge (*loc. cit.*) have recorded a tetraploid form of *A. evecta* from Ceylon with $n = 80$.

The meiosis is normal in all the members investigated. A fuller report appears elsewhere.

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element in the electron cloud present in the crystal proportional to its local density. This scattering power derives from the fact that the electrons would be set in motion and oscillate with the same frequency as that of the electro-magnetic field which the incident X-ray beam represents. On this basis, the scattered radiations from all the volume elements would have the same frequency as the incident X-rays, as also specific phase relationships determined by their relative positions. The scattered radiations therefore would be capable of reinforcing each other's effects in certain specific directions determined by the wave-length of the X-rays and the spacing of the stratifications, in accordance with recognised optical principles. Concentrations of intensity accordingly appear in the directions representing a highly restricted selection of wave-lengths from the incident white X-radiation.

3. Atomic Nuclei and X-Ray Diffraction

The foregoing picture is obviously however an over-simplification. It implicitly assumes that the electrons which scatter the X-rays remain firmly bound to the structure of the crystal and that the latter also remains otherwise unaffected by the passage of the X-ray beam. The strength of the binding of the electrons to the atomic nucleus or nuclei closest to them necessarily enters into the picture and would influence the intensity and phase of the scattered radiations to an extent determined by the approach of the frequency of the incident X-radiation to the characteristic X-ray absorption frequencies of the electrons. Indeed, recent X-ray researches have shown that these factors have to be taken into account in the theory of X-ray diffraction by crystals.

The foregoing remarks indicate that considerations somewhat analogous to those which enter into the theory of scattering of light in crystals need to be taken into account also in the theory of X-ray diffraction. When a beam of common light traverses a crystal, its wave-length is ver great in comparison with the spacing of th electronic stratifications in the crystal an the latter do not therefore reflect the inc dent radiation but merely transmit it. C the other hand, it is known that the passag of the light excites vibrations of the atom nuclei with the result that if the incide light be monochromatic, scattered radiatio are observed exhibiting sharply defined shif of frequency corresponding to the characte istic vibration frequencies of the atom nuclei about their positions of equilibriur The appearance of such scattered radiatio indicates the existence of a coupling be ween the forced vibrations of the electro under the influence of the incident electr magnetic field and the natural or free vibra tions of the atomic nuclei about their pos tions of equilibrium. In the language of th quantum theory of dispersion, the appea ance of such frequency shifts is describe by the statement that the system compose of the nuclei and electrons does not—follow ing the virtual transitions to higher energ states induced by the incident radiation- return to the same level as previously bu shifts to a third level in which the atom nuclei are in a different energy state vibration.

In the X-ray experiment, the frequen of the incident radiation is usually muc higher than the characteristic frequencies the electrons. Nevertheless, the ideas of th quantum theory of dispersion continue to b applicable and the question therefore aris whether the incident X-radiations can al excite transitions in the energy state of th atomic nuclei by virtue of their mechanic coupling with the electrons and if so, wha would be the observable result of suc transitions. We shall now proceed to answe these questions.

4. The Characteristic Vibrations of Crystal Lattices

As remarked earlier, the fundament feature of crystal architecture is that it

a repetitive pattern in three-dimensional space of a characteristic unit of the structure containing a finite number of atoms. Each unit of the structure is similar to and similarly situated with respect to the units surrounding it. Hence it follows that in respect of all their physical properties the units of the crystal structure would be similar to each other; in particular the dynamic behaviour of all the units of the crystal structure would be completely identical. We may put the same situation in slightly different language by saying that every crystal is an assembly of atomic oscillators all of which have identical modes and frequencies of vibration. What these modes and frequencies are is a matter for rigorous mathematical investigation. Such investigations have been carried out and published in recent papers which have appeared in the *Proceedings* of the Indian Academy of Sciences. It emerges that all the atoms in the crystal have $(24p-3)$ modes and frequencies of vibration in common. $(3p-3)$ of these frequencies represent modes in which equivalent atoms in neighbouring cells oscillate with the same amplitudes and in identical phases, while for the remaining $21p$ frequencies, equivalent atoms in adjacent cells oscillate with the same amplitudes but with phases which may be the same or else opposite along one, two or all three axes of the lattice. This picture of the dynamical behaviour of the atoms in a crystal has important consequences for the subject of X-ray diffraction which we shall now proceed to consider.

5. A Classical Analogue

It is useful in the first instance to consider the position from a purely classical standpoint so that the consequences arising therefrom may be taken over into the quantum-mechanical treatment of the problem. We shall restrict ourselves here to a consideration of the $(3p-3)$ modes of vibration of the atomic nuclei in which the vibrations in the different cells of the crystal lattice are identical in all respects. In such a vibration it would follow that the stratifications of electron density in the crystal would not remain in fixed positions but would oscillate to and fro with the frequency equal to that of the mode of vibration concerned. An X-ray beam traversing such stratifications would continue to be reflected in the same direction as in the static case. But in consequence of the periodic motion of the stratifications (assumed to be of small amplitude), the reflected X-ray beam would now consist of three spectral components having frequencies respectively ν, $(\nu+\nu^*)$ and $(\nu-\nu^*)$, ν being the incident X-ray frequency and ν^* that of the oscillation of the lattice. The additional components arising by virtue of the oscillations may be regarded as Doppler shifts of frequency resulting from the movement of the stratifications normal to themselves. The amplitudes of the additional components would be determined by the ratio of the amplitude of the oscillations to the wave-length of the X-rays.

The above classical result translated into the language of quantum mechanics would mean that the incident X-radiation traversing the crystal may excite the characteristic vibrations of the lattice, and if such excitation actually occurs, the beam would be reflected in the same direction as in the absence of such excitation but with diminished frequency. If, on the other hand, the characteristic vibration is already present by reason of thermal agitation, the crystal may be de-excited and the incident X-radiation would then be reflected with increased frequency.

6. Infra-Red Activity and X-Ray Diffraction

It will be seen from the foregoing that the mechanism which can give rise to X-ray reflections of altered frequency is altogether different from the mechanism which results in the scattering of light with frequency shifts in crystals. In the latter case

RECENT TRENDS IN APPLIED MATHEMATICS*

THIS volume contains the manuscripts resulting from the invited addresses delivered at the symposium on Applied Mathematics held at the University of Chicago on 29 and 30 April 1954. The value of the papers in the collection has been enhanced by the fact that the manuscripts were drafted after the conference, and consequently included material which was brought out during the interesting discussions. The symposium was sponsored jointly by the American Mathematical Society and the Office of Ordnance Research, U.S. Army, and looking at the names of the participants in the symposium, it is evident that the conference must have stimulated contacts between scientists in the Universities and those in Government Institutions.

There is an amazing variety in the topics dealt with in the book, and this variety comes as an eye-opener to those nurtured in the old classical school of applied mathematics. The first article on Operations Research by P. M. Morse serves to emphasise correctly the nature, the importance, and the techniques of this new field of activity. He has considered three typical problems, *viz.*, the waiting line or queueing theory and the associated Monte Carlo procedure, the linear programming problems, and problems amenable to Neumann's game theory. Finally a new type of problem called the theory of the optimum distribution of effort has been set up, and its intimate connection with applications to military operations, and industry or business activities has been fully explained.

The next two articles by Neyman and Hartley respectively are statistical in character. Neyman has satisfactorily settled a fundamental question relating to modern mathematical statistics by showing that it can be based on the theory of inductive inference which should be considered to belong to the conceptual and not phenomenal, sphere of thought, and that it can be applied in all cases where a stochastic model has been adopted to represent a given class of phenomena. This has been illustrated in an illuminating way by considering the phenomenon of neutral V-particles in nuclear physics, and their decay. The other article by Hartley on recent developments in analysis of variance gives a comprehensive survey of the subject, and presents the most recent developments relating to this valuable statistical technique.

Papers 4-6 relate to computational methods, and numerical analysis. In a brilliant paper on the motivation for working in numerical analysis, John Todd has discussed most of the important and attractive topics that can be handled by this method. Problems in game theory and Monte Carlo processes are shown to be amenable to computational procedures. Recent activity in numerical analysis is illustrated by pointing out biological applications, and applications to combinational analysis, number theory, algebra and topology. Iterative computational methods have been explained by M. R. Hestenes, and shown to be an improvement on the usual methods. The advent of high speed automatic digital computers enables the employment of such methods, and Hestenes has indicated applications to matrix inversion, and matrix eigen-values. Perhaps the finest indication of what has been achieved by numerical computation is given in the article by A. A. Bennet by considering Ordnance problems. He has listed some forty of the most important computing projects undertaken in the Ballistic Research Laboratories of the U.S. Army Ordnance Corps at Aberdeen Proving Ground which operate the best equipped modern high-level computing facilities in the world.

What is more interesting than the wonderful variety of these topics is the awakening of interest, resulting from computational techniques, in many long-neglected fields of pure mathematics. The prophecy of Hermann Weyl that the methods of mathematics considered as formal logic have reached saturation limits, and that new advances can be expected with the help of devilishly fast computing machines, appears to be coming true. Bennet has also indicated very correctly that the problems of a computing laboratory are problems of personnel, not of clerks who can come running at the call of a push-button, but of scientists who can devise the right push-button for slave machines. That these are, after all, slaves is well brought out by the fact that while the fastest modern computing machine would require something over 108 years of continuous errorless operation to invert an ordinary matrix of order 20 by the traditional method of determinants and co-factors, a better suited method can be devised to accomplish this inversion in a few hours.

Papers 4, 8 and 9 relate to what might be called classical applied mathematics. J. E. Mayer has listed two unsolved problems of statistical mechanics, one in which the mathematical equation can be correctly formulated but cannot be solved in a general way although

* *Transactions of Symposia in Applied Mathematics*, Vol. II. Sponsored by The American Mathematical Society and Office of Ordnance Research, U.S. Army, No. 2. (Interscience Pub.), 1955, Pp. 216, Price $5·00.

approximate methods can be used, and another which cannot be set up mathematically because of logical difficulties, although particular cases can be specifically solved. It is shown that the latter case is due to the fact that a simple and useful definition of entropy which can at least lend itself to computational procedures is lacking, and that a fundamental mathematical clarification is therefore needed. In a paper on the simplest rate theory of elasticity, Truesdell has set up a new type of what he calls the theory of the isotropic hypo-elastic body of grade zero, a non-linear field theory which is dynamically admissible for strains and rotations of any magnitude. The theory is a natural extension of the classical one, and appears more satisfactory than even the usual finite strain theory. The notion of stability of mechanical systems has been subjected to a thorough analysis in a paper by J. J. Stoker, and a most interesting example, where stability considerations arise, is given of a new type of synchrotron which would increase the energy of the particles used to bombard atoms by a very large factor. The question of stability which, here, is equivalent to the existence of relatively small deviations from a circular orbit, requires an adequate theoretical analysis since an experimental check cannot be carried out, for the individual particles go around the synchrotron hundreds of thousands of times, and even the most modern high speed digital counters have far too little capacity to carry out numerical computations with accuracy over trajectories which are so long.

The last two papers, are devoted to differential equations and differential operators. In a long paper of over 60 pages, F. J. Burean discusses comprehensively the abstruse notion, due to Hadamard, of the finite part of a divergent integral, and considers Cauchy's problem for the wave equation, and the Euler-Poisson-Darboux equation. Elegant and general solutions are obtained and numerous applications are indicated. The paper closes with a very valuable and comprehensible bibliography. In the last paper of the series, W. Feller discusses the most general class of operators with certain characteristic properties, and shows that these operators can be viewed in a new light as operating in the Banach space of measures where the notion of self-adjointness becomes irrelevant. It is also shown that the introduction of these generalised parameters achieves a considerable simplification and unification of the theory.

The material covered in this symposium is sure to be of the highest significance to all workers in modern applied mathematics and allied fields.

B. S. MADHAVA RAO.

SCIENCE NOTES AND NEWS

Kalinga Prize Award to Dr. August Pi Suner

Dr. August Pi Suner, Spanish Physiologist and Director of the Institute of Experimental Medicine at the University of Caracas, Venezuela, has been awarded the 1955 Kalinga Prize for his work in popularizing science in Spanish-speaking countries.

Born in Barcelona in 1879, Dr. Pi Suner joined the University of Caracas as a Professor of Physiology following a distinguished career in teaching and in research in Spain. In 1922, he received the Achucarro National Prize in Spain for his research in the physiology of the nervous system and, in 1948, he was awarded the Prix Pourat of the Paris Academy of Sciences for his book, *The Vegetative Nervous System.*

In addition to his scientific works, Dr. Pi Suner is the author of an extensive series of books intended to bring science within the grasp of the layman. Among his works which have been translated into English are *The Bridge of Life* and *Classics of Biology.* He has been widely translated into French and above all, he has made an important contribution to the popularization of science in the Spanish-speaking countries.

Synthesis of Benzene by Irradiation of Acetylene

Benzene has been synthesized from acetylene by bombardment with β-rays from tritium at the Laboratories of the General Electric Co., U.S.A. At 26° C., about 72 molecules of acetylene are converted either to benzene or cuprene per 100 e.v.. of radiation energy. As the benzene yield is about 5 molecules per 100 e.v., about 21% of the acetylene consumed goes into the formation of benzene. The fraction of acetylene converted to benzene is found to be independent of acetylene pressure and radiation intensity.

in the crystal are located at the points of a Bravais lattice, and if the crystal consists of p interpenetrating Bravais lattices, there would be p atoms in each unit cell of the crystal structure. Since the frequencies of vibration of the atoms are determined by their masses and by the interatomic forces which are of limited range, they would necessarily be the same for the group of atoms contained in every cell of the structure. Hence every crystal may be considered as an assembly of a great number of oscillators physically similar to each other and having a set of vibration frequencies in common, and which since the oscillators can exchange energy with each other, constitute a system in thermodynamic equilibrium. Each oscillator can for any particular frequency of vibration assume any of the energy states permitted by the quantum theory, the probability of its being present in any one state being given by Boltzmann's well-known formula. The energy of the entire assembly of oscillators can therefore be evaluated by multiplying the number of oscillators of any particular frequency by the average energy of an oscillator of that frequency which is calculable from the relative probabilities of its different energy states, and then summing up the results for all the frequencies. The total number of oscillators included in such a reckoning would be three times the number of atoms comprising the crystal. This follows from the theorem in classical mechanics which states that the number of normal modes of vibration of a connected system of particles is the same as the number of degrees of freedom of movement of the entire system.

3. Dynamical Theory

The dynamics of atomic vibration in a crystal may be dealt with from two different standpoints which may be designated as the "molecular" and "molar" points of view respectively. In the "molecular" approach to the problem, we fix our attention on a particular unit cell of the crystal structure and proceed to write down and solve the equations of motion of the p atoms conta ed in it, with a view to discover and er merate their normal modes of vibration. doing this we have necessarily to ta account of the forces arising from the mo ments of the atoms in the surrounding ce which interact with those in the cell un consideration. It is obvious that no mode vibration of the atoms in the unit cell persist unchanged unless the atoms in surrounding cells also vibrate in a simi mode with the same frequency. This wo be the case if equivalent atoms in these ou cells also vibrate with the same amplitud but as regards their phases of vibrati there are several distinct possibilities. formal investigation shows that there $2 \times 2 \times 2$ or eight possibilities in all wh can be described as follows: The phases equivalent atoms are either the same or o opposite in consecutive cells along one, two, or all the three axes of the Bravais l tice. The identity of the amplitude of vib tion of equivalent atoms reduces the nu ber of independent co-ordinates to $3p$ or Thus, the equations can be solved and sult in $3p$ solutions, but as there are ei different situations in respect of the phas we have $8 \times 3p = 24p$ solutions in all. T is the same as the number of degrees dynamic freedom of the $8p$ atoms contair in a super-cell having twice the linear dime sions of the unit cell of the crystal stru ture. Accordingly, we recognize $(24p -$ normal modes of vibration properly called, the three omitted degrees of freed representing the translatory movements the super-cell.

In the "molar" approach to the proble we consider the entire crystal as a sin physical entity and investigate the prop gation of waves through its structure. T wave equations are found to be forma satisfied if it be assumed that the equivale atoms located at the points of a Bravais l tice have the same amplitude of vibrati

this however being different for the different lattices of atoms, while the frequency, wave-length and the direction of the wave-vector are the same for all the interpenetrating lattices. Proceeding to solve the set of $3p$ equations obtained on this basis, an algebraic equation of degree $3p$ for the frequency results, and the solution of this gives us $3p$ different frequencies for a wave of given wave-length travelling in any assigned direction. By considering the functional dependence of these $3p$ frequencies on the wave-length and direction of propagation, it is found that the group-velocity of the waves vanishes for $(24p-3)$ frequencies associated with eight different wave-vectors in the crystal. The $(24p-3)$ frequencies thus obtained and the corresponding modes of vibration are found to be the same as the frequencies and normal modes deduced by the "molecular" approach to the problem, namely, those in which equivalent atoms in consecutive cells vibrate with the same amplitude and with phases that are either the same or else opposite along one, two or all three of the Bravais axes of the crystal. They may therefore be identified as the characteristic or normal modes and frequencies of vibration of the crystal structure. The three omitted frequencies represent the limiting case of the three sets of waves of the lowest frequencies and the longest wave-lengths for which the group velocity does not vanish but comes out as equal to the phase-velocity of the waves. These cases are identifiable with the three types of waves whose propagation in any direction in the crystal is shown to be possible by the classical theory of elasticity. The vanishing of the group velocity for all the $(24p-3)$ frequencies characteristic of the lattice structure is significant. It indicates that no wave-propagation in any real or physical sense is possible in a crystal except in the lowest range of frequencies where alone the ideas and results of the classical theory of elasticity possess any validity.

4. The Spectrum of the Thermal Agitation

The results of the dynamical theory enable us to complete the thermodynamic picture already indicated above in outline. The p interpenetrating Bravais lattices of atoms constituting the crystal represent an assembly of atomic oscillators which have a set of $(24p-3)$ vibration frequencies in common. Each of these oscillators can assume one or another of the various energy states for these frequencies permitted by the quantum theory, the relative probabilities of the same being given by the Boltzmann formula. It would not be possible to specify or predict which of the great number of oscillators in the crystal would be in a particular excited state for any of its possible frequencies of vibration at any given instant. In other words, the thermal energy would be distributed through the volume of the crystal in a manner which fluctuates from place to place and from instant to instant in an unpredictable fashion. The fluctuating character of the energy distribution would be the more striking, the higher the frequency under consideration, since the energy jumps indicated by the quantum theory are proportional to the frequency.

Thus, it emerges that $(24p-3)$ out of every $24p$ degrees of freedom of atomic movement in the crystal manifest themselves in the thermal agitation as modes of internal vibration with a precisely defined set of monochromatic frequencies and in modes specifically related to the crystal structure, though they are localised in the crystal in a chaotic and unpredictable fashion. The residual 3 degrees out of every $24p$ degrees of freedom represent, as we have seen, the translatory movements of the super-cells of the crystal lattice. Such movements would disturb the regularity of the crystal structure, in other words, would give rise to stresses and strains of the same general nature as those contemplated in the classical theory of elasticity. Hence, the 3 residual

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DETERMINATION OF ULTRASONIC VELOCITY IN SOME COMPLEX CHLORIDES OF MERCURY

A number of workers[1–6] have shown that when solutions of $HgCl_2$ and KCl are mixed in different proportions, then complexes are formed if the ratio of the number of molecules of the two are as 1 : 1 or 1 : 2 or 2 : 1. In particular, the formation of the compound K_2HgCl_4, and the occurrence of the ion $HgCl_4^{--}$ have been definitely established. Evidence for the formation of the ion $HgCl_3^-$ has been obtained from surface tension,[2] Raman spectra[3] and solubility measurements.[4,5] In the present note, ultrasonic data are presented which confirm the existence of the ion $HgCl_3^-$.

Ultrasonic velocities were measured at 29° C. for the solution corresponding to the concentrations mentioned in Table I. All the solutions contained 20 g. of $HgCl_2$ in 250 ml. of solutions, while the concentration of KCl is as given in column 1.

Table I

Amount of KCl in g.	Ratio of number of molecules KCl : $HgCl_2$	Velocity metres/sec.
0·00	0 : 1	1484·9
2·75	½ : 1	1488·9
5·50	1 : 1	1490·6
8·25	1½ : 1	1495·7
11·00	2 : 1	1501·2

On drawing a graph between the measured velocity and the corresponding amount of KCl added we do not get a uniform increase in

but there is a clear discontinuity in e at KCl. $HgCl_2$ as shown in Fig. 1.

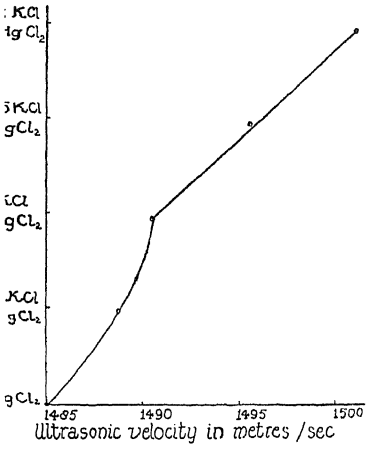


FIG. 1

ests the formation of a new compound tion of KCl. $HgCl_2$ yielding the ion The detailed paper will be published

epartment, J. R. SARAF.
University, P. N. SHARMA.
August 1, 1955.

c and Noyes, *Z. anorg. chem.*, 1890, **6**, 389.
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MPORTANCE OF THE POINT ECTION IN THE VISCOSITY-E CURVE OF THE SLOW GULATION OF COLLOIDS

en clearly observed that under ordiitions the rate of slow coagulation ocatalytic character with most coagu- the viscosity-time curves are thereped. While studying the kinetics of ılation of As_2S_3 sol, it has been ob- the points of inflection ($d^2x/dt^2 = 0$) osity-time curves obtained by adding oncentrations of the electrolyte are because they denote the same kine- n the process of coagulation. Hence s may be considered to be governed e state of the size, shape and charge gregated particles. In other words, corresponding to the points of iny be reasonably assumed to be such as to give the same stage of coagulation attained by adding different concentrations of the electrolyte.

In previous communications,[1] the relation between the time of coagulation t and the concentration C of the electrolyte was expressed by the equation,

$$C = a + \frac{m/t}{(n+1/t)}$$

where a, m and n are constants. This equation can be reduced to the form

$$\frac{1}{C-a} = \frac{n}{m}\,t + \frac{1}{m}$$

where $1/(C-a)$ is linear with t.

The degree of coagulation was determined by measuring the relative change of viscosity given by $(T - T_0)/T_0$ where T_0 is the time of efflux without adding the coagulating electrolyte and T is the time of efflux after the addition of electrolyte at different time intervals. $(T - T_0)/T_0$ was then plotted against the corresponding time intervals for different concentrations of electrolyte, and the points of inflection were then determined from the curves as shown in Fig. 1. The reciprocal of the different times

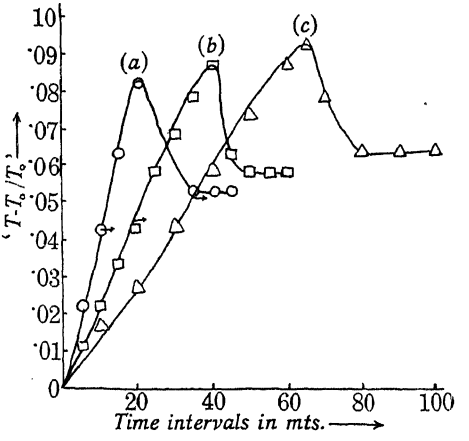


FIG. 1. Concentration of the As_2S_3 Sol—0·09 M,
Curve (*a*) → Electrolyte Concn. = 0·45 M
Curve (*b*) → Electrolyte Concn. = 0·45 M
Curve (*c*) → Electrolyte Concn. = 3·45 M

$(1/t)$ corresponding to the points of inflection obtained from the degree of coagulation and time curves of the As_2S_3 sol were plotted against the respective concentrations (C) of the electrolyte (KCl) used. The intercept obtained on the C-axis gave the value of the constant a, *i.e.*, when $1/t = 0$ (see Fig. 2). Knowing a, $1/(C-a)$ was plotted against t and the curve was found to be linear, which confirms the

The symptoms, host range and virus vector relationships of *bhendi* yellow vein-mosaic have already been published in detail.[7,8] The virus of yellow vein-mosaic of pumpkin is new; therefore, its symptoms, etc., are described here in brief. The virus is not sap transmitted but

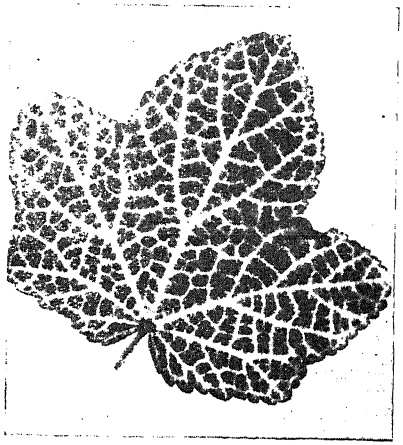


FIG. 1. A *bhendi* leaf showing yellow vein-mosaic.

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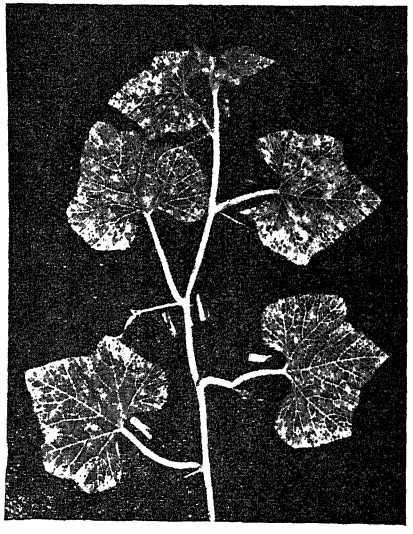


FIG. 2. A pumpkin leaf showing yellow vein-mosaic.

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White-flies raised in insect-proof glasshouse on healthy cotton plants were first fed for 24 hours on diseased *bhendi*, and then during the next 24 hours on diseased pumpkin plants and *vice versa*. Samples of insects from the two lots were transferred to healthy *bhendi* and pumpkin plants in succession for 9 days allowing them to feed for 24 hours on each host.

Observations indicated that the respective viruses were transmitted to the hosts from which they were acquired by the vector. Similar results were obtained when the feeding period on healthy test plants was reduced to 12 hours.

The results reported here conclusively show that the cotton white-fly is capable of harbouring two different viruses simultaneously and can readily cause infection in healthy host plants susceptible to the respective virus on the same day and can continue to do so for several days without having recourse to the source of infection. Further work with more than two viruses is in progress.

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REVIEWS

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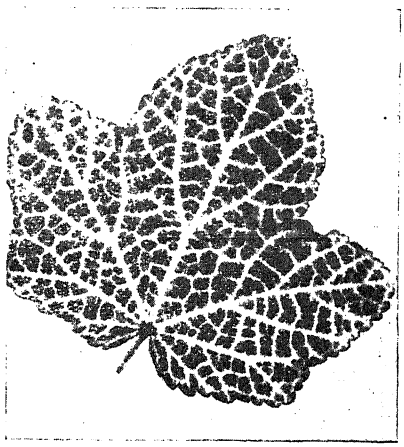


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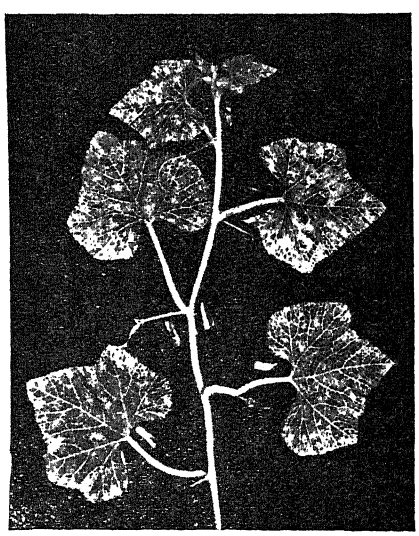


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germ-tube (Fig. 1, *d*). The formation of a septum at the base of the first germ-tube usually occurs before the development of the second germ-tube (Fig. 1, *e*) or before the migration of a nucleus into the latter (Fig. 1, *l*), but it may also be further delayed.

In the stained preparation of a dicaryotic mycelium the nuclei, in some cases, seem practically to occupy the entire width of the hyphal cells (Fig. 1, *p*). The hyphal cells are usually dicaryotic in the sense that they have a paired condition of nuclei, although 3-4 nucleate cells are not altogether uncommon (Fig. 1, *l*, *m*, *o*, *p*, *r*). The clamp-connections are not very frequent in their occurrence. Therefore, the same hypha may have septa with or without clamp-connections (Fig. 1, *o*, *p* and *r*). The nucleus in all cases can be seen as a deeply stained chromatin-body often surrounded by a hyaline zone separating it from the nuclear membrane.

Dept. of Botany, SACHINDRANATH BANERJEE.
Calcutta University, ASOKE KUMAR SINHA.
Calcutta-19,
March 29, 1955.

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A NEW *PHYLLACTINIA* FROM MADHYA BHARAT

WHILE on a visit to Sukhanand Temple which lies 5 miles north of the Town of Jawad (24° 36′ N., and 74° 52′ E.) in the Mandsaur District of Madhya Bharat, the writer collected a *Phyllactinia* in cleistothecial stage on the fallen leaves of *Cordia dichotoma* Forst. In establishing it as a new species the author is closely following the treatment of the genus as advocated by Blumer,[1] Linder,[2] and Doidge.[3]

In Table I the present species has been compared with others possessing larger cleistothecia. The dimensions of cleistothecia, asci, and ascospores of *P. salmoni* Blumer, *P. hippophäes* Thuem., *P. robonis* (Gachet.) Blumer, *P. suffulta* (Rebent.) Sacc., and *P. elægni* Linder are taken from Linder,[2] while those of *P. combreti* Doidge from Doidge.[3] It is a pleasure to dedicate this species to Dr. M. J. Thirumalachar whose contributions to Systematic Mycology in India are so vast and varied.

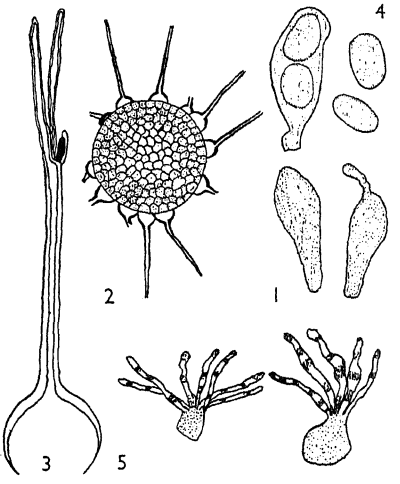


FIG. 1. Two conidia, one germinating at its apex × 253. FIG. 2. A cleistothecium in surface view, × 60 FIG. 3. An appendage proliferating into four branches (one darkened in the figure), × 327. FIG. 4. An ascus and two released ascospores, × 208. FIG. 5. Two separated penicillate cells, × 327.

Phyllactinia thirumalachari Payak spec. nov

Mycelium hypophyllum, operiens totam lamiinam, persistens, pallide album. *Conidia* (Fig. 1 acrogena, solitaria, rhomboidea vel lanceolata vel subclavata, hyalina, irregulariter atqu dense verrucosa, 49·4-83·6 × 15·2-26·6 μ. *Cleistothecia* (Fig. 2) hypophylla numerosa, dispersa, raro gregaria, brunneo-nigra, sphærica 190-342 μ diam. *Appendices* (Fig. 3) 20-25 i

TABLE I

Species	Cleistothecia		Asci		Ascospores
	No. of appendages	Diameter in microns	No. of Asci	Size in microns	Size in microns
P. salmoni	10–30	294–362	20–30	80–110 × 30–50	35–45 × 20
P. hippophäes	Many	246–275	25–40	70– 80 × 25–40	20–35 × 15–20
P. robonis	15–30	214–250	15–30	70– 90 × 25–35	30–40 × 19–23
P. suffulta	6–12	160–230	10–30	70–100 × 25–50	25–40 × 15–25
P. elægni	8–13	247–303	30–35	97–110 × 34–42	38–47 × 19–23
P. combreti	15–20	275–400	40–50	80– 95 × 27·5–37·5	35–40 × 17·5–25
P. thirumalachari	20–25	190–342	25–35	68– 95 × 27–34	23–42 × 17–23

singulis cleistotheciis, æquatoriales, bulbosæ ad basim, fastigatæ vel rotundatæ ad apicem, centro hyalino, rigidæ, nonnumquam binæ ex unica basi, vel proliferantes in duos tresve ramos prope apicem, breviores diametro cleistothecii vel ei æquales, 220-342 μ longæ. *Asci* (Fig. 4) 25-35 un singulis cleistotheciis, luteo-aurantiaci, subcylindrici vel late clavati, acute desinentes in uncum vel paxillum ad basim, nonnumquam apicilater crassi, magnit. 68-95 × 27-34 μ. *Ascosporæ* (Fig. 4) ovato-ellipticæ vel angulariter globoideæ ob mutuam pressionem, aurantiacæ, parietibus lævibus, binæ vel quaternæ in singulis ascis, magnit. 23-42 × 15-23 μ. *Cellulæ Penicillatæ* (Fig. 5) plurimæ, bene evolutæ, *plus* minusve persistentes.

Habitat in foliis deciduis *Cordiæ dichotomæ* Forst. in loco Sukhanand, proper Jawad, in Distr. Mandsaur, in Statu Madhya Bharat, die 5 martii, 1953; typus lectus a M. M. Payak.

The type is being deposited in the Herb. Crypt. Indiæ Orient., New Delhi, Herbarium of the Commonwealth Mycological Institute, Kew, U.S. National Fungus Collection, and Farlow Herbarium of the Harvard University.

I am indebted to Dr. S. P. Agharkar for his interest and encouragement, to Rev. Father H. Santapau, S.J., for furnishing the Latin diagnosis and finally to Dr. M. J. Thirumalachar for his invaluable help and advice.

Botany Lab., M. M. Payak.*
MACS, Law College Building,
Poona, *June* 7, 1955.

* Junior Research Fellow of the National Institute of Sciences of India.

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OCCURRENCE OF *SERRATIA MARCESCENS* BIZIO ON CUTWORM FROM INDIA

The "prodigious" or "miraculous" bacterium *Serratia marcescens* Bizio (Syn. *Chromobacterium prodigiosum* Topley and Wilson, *Bacterium prodigiosum* Lehmann and Neumann) has not yet been reported to occur in India. In the course of investigations on control of insects by microbiological methods, a bacterium was isolated from *Agrotis Ypsilon* (cutworm insect commonly occurring in West Bengal on cabbage, potato, cauliflower, etc.). The pure culture of the bacterium was made on nutrient agar and it was identified as *Serratia marcescens* Bizio. As the bacterium is being reported for the first time in India and as considerable variation exists in the species a short description of the organism isolated is given below :

Morphological Characters.—Single to chained cells, spherical, measuring 0·4 to 0·8 μ rigid, polymorphism reported by Reed[1] was not noted. The organism is gram negative, motile with peritrichous flagella, non-capsulated, non-spore-forming, aerobic to facultative. The organism is usually deep red in colour due to presence of a pigment prodigiosin.[2]

Cultural Characteristics.—On nutrient agar, colonies are mostly smooth (99% smooth, 1% rugose), circular, raised, entire, undulate to lobate, red to shiny pink. Pigmentation starts at the very initiation of growth and within 24 hours the colonies have the characteristic red to shiny pink colour. On plating out, the red colonies usually give rise to a few white colonies. The white ones tend to remain white in subsequent generations.

On nutrient agar slants, 24 hr.-old culture shows moderately heavy growth. Growth is smooth, with moist layer, filiform with tendency to become echinulate.

In nutrient broth, 48 hr. growth shows the presence of red ring with deposition of red sediment. Pellicle formation is absent. Motility is noticed in young as well as one week-old culture.

The organism fails to grow on a medium containing 1% glucose, 0·2% sodium nitrate, 0·5% potassium dihydrogen phosphate and 0·2% magnesium sulphate, but when sodium nitrate is replaced by ammonium salts, moderate growth takes place, but pigmentation is usually lacking.

On sterilized potato cylinders, growth is moderate at the beginning, but within 72 hours it becomes heavy. Pigment formation is intense and the pigment formed is deep red to dark, the potato cylinders however remaining colourless.

Biochemical Characters.—Gelatin liquefied within 3-5 days; Litmus milk—acid formation followed by curdling, casein completely digested and pigment formed in the milk; H_2S—not liberated; Reduction of nitrate—satisfactory in 2% peptone broth containing KNO_3; NH_3—formed; Utilisation of carbon sources—acid, but no gas is produced in glucose, lactose, sucrose, mannose and glycerol.

Pigment formation is found to be dependent on presence of organic nitrogen in the medium and suitable temperature and takes place between 24° C. and 36° C., the optimum temperature being 28-30° C. The pigment sometimes,

(*a*) the total alkaloids have activity against all the organisms tested.

(*b*) *Staphylococcus aurcus* and *Shigella sonne* are more susceptible than the other organisms.

(*c*) reserpine in 1/10 dilution has no anti-microbial property.

(*d*) no appreciable difference in the inhibitory concentration is noticed between the alkaloids and the solvents used against *Myco tuberculosis* $H_{37}R_v$. Hence, the alkaloids can be considered to be without anti-tubercular activity.

It is particularly significant that the total alkaloids inhibit the growth of *Staphylococci* and *Shigella sonne*. Many outbreaks of diarrhœas are, of late, being attributed to these two organisms, and hence, the use of *Rauwolfia* decoctions in such conditions may be explained. However, controlled clinical trials are essential to translate the "*in vitro* activity" to therapeutic use.

Thanks are due to Ciba Pharmaceuticals, Inc., Basle, for generous supply of reserpine ('Serpasil') and to the Himalayan Drug Co., for the roots of *Rauwolfia serpentina* (Benth.). The authors wish to thank Dr. K. P. Menon for valuable advice.

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USE OF HEAVY WATER IN ORGANIC CHEMISTRY

IN the organic synthesis section, Division of Pure Chemistry, National Research Council, Canada, the following organic compounds labelled with deuterium have been synthesized for use in chemical kinetics, photochemistry and spectroscopy.

(1) Decomposition of the carbide Mg_2C_3 with deuterium oxide gives an excellent yield of propyne-d, $CD_3C \equiv CD$. Several other compounds can be prepared from this material. For instance, chlorination gives 1, 1, 2, 2-tetrachloropropane-d_4, ($CD_3CCl_2CDCl_2$) from which, in turn, 1, 1, 2-trichloropropene-d_2 or *cis*- and *trans*-1, 2-dichloropropane-d_4 can be prepared.

(2) Addition of deuterium bromide to a double or triple bond is another simple method of introducing deuterium into organic compounds. Thus acetylene-d_2 gives a quantitative yield of 1, 2-dibromoethane-d_4. Alternatively, deuterium bromide may be reacted with ordinary acetylene to give 1, 2-dibromoethane-1, 2-d_2. It has been possible to transform both of these compounds into others, *e.g.*, ethylene-d_4, ethyl-d_5 bromide, ethylene-d_4 oxide, etc.

(3) Deuteration of organic compounds can also be effected by exchange. Such reactions are catalysed by finely divided metals such as nickel or platinum. For example, benzene is easily deuterated to benzene-d_6 by repeated exchange with deuterium oxide in the presence of platinum black. Exchange reactions may also be catalyzed by acids or bases. Trichloroethylene readily exchanges its hydrogen for deuterium when heated with deuterium oxide containing a weak base. An example of an acid-catalyzed reaction is the conversion of malonic acid to malonic-d_2 acid-d_2, namely, $CD_2(CO_2D)_2$.

(4) Sometimes it is more expedient to prepare a compound by reacting a suitable starting material with deuterium oxide and then enriching the product by exchange. For example, about 20 exchanges are required to convert acetone to acetone-d_6. Considerable time is saved by just preparing deuterated acetone (about 90%) from deuteroacetylene and then enriching it by exchange with heavy water.

The greatest difficulties are encountered in the synthesis of compounds labelled with deuterium in a specific position. A discerning choice of starting material must often be made. For instance, when it recently became necessary to prepare butene-1-4, 4, 4-d_3, $CD_3CH_2CH = CH_2$, the problem was solved by reacting the halide $CCl_3.CH_2.CHBr.CH_2Cl$ with zinc and acetic acid-d. In another case, acetaldehyde labelled in the formyl group was prepared by applying Nef reaction to the deuterated nitroethane, $CH_3CD_2NO_2$. The formation of the acetaldehyde-d, disproved a mechanism proposed for the Nef reaction in 1950. These synthetic methods are being extended in several directions. (*N.R.C. Res. News*, Vol. 8, No. 2).

RECENT RESEARCHES IN THE PALÆONTOLOGIC DIVISION GEOLOGICAL SURVEY OF INDIA*

M. R. SAHNI

Palæontologist, Geological Survey of India

esent article gives a short review of the ous items of research carried out in the ent of Palæontology, Geological Sur- India, during the period of the First ır Plan.

INVERTEBRATES

rolines from the Indian Continent, et and Pakistan and Age of the Associated Volcanic Series

Sahni and V. V. Sastri have made an ve investigation of the orbitolines so ected from Chitral, Gilgit, Kashmir, Himalaya and Tibet. These include, the new genus *Birbalina* (genotype *ıra*, sp. nov.) allied to *Orbitolinella* the following new species and varie- *a*) Chitral: *Orbitolina chitralensis* -Lower Cenomanian); (b) Gilgit: *hitralensis*; (c) Kashmir: *O. kash-* Aptian-Albian); (*d*) Tibet: *O. obesa*; ma: *O. raoi*, *O. wadiai* and *O. hukaun-*

result of detailed study, the authors that the volcanic sequence in the Valley, Kashmir, should be equated to jal Trap Series, not the Tertiaries, as by Wadia, for such Tertiary genera *ıoconoides*, *Alveolina*, etc., supposed to the Burzil Valley sequence, were not ı any of the rock samples, while the l *Dictyoconoides* formerly identified in etaceous sequence, are undoubtedly *ıa*.

ailed account will be published as a aph in the *Palæontologia indica*.

Fossils from the Jurassic Rocks of Jaisalmer, Rajasthan

Sahni and N. C. Bhatnagar have in- ed a Callovian fauna from Jaisalmer g the following: Genus *Jaisalmeria*, enotype *J. taylori*, sp. nov.). *Generic is*: beak more or less erect, free of the umbo, characterised by well developed, es sharply angular, submesothyrid beak deltidial plates probably disjunct; orna- on consisting of numerous, fine, radiat- s.

meria taylori sp. nov.: shell broadly omewhat depressed but almost equi- convex, biplicate. Beak small, erect, obliquely truncated by a small foramen. *Jaisalmeria depressa* sp. nov.: shell depressed, sub-pentagonal, incipiently biplicate, beak small, erect, beak-ridges well defined, enclosing a broad area below. *Jaisalmeria ovalis* sp. nov. var. *cuneata*, nov. is posteriorly narrow and possesses incipient dorsal sulcation separated by folds.

? Kutchithyris jaisalmerensis sp. nov.: shell ovate to subpentagonal; strongly biplicate, sub-fimbriate; beak massive, well incurved; beak-ridges permesothyrid; foramen large.

Hemicidaris jaisalmerensis sp. nov.: test small, circular around the ambitus. Oral surface flat, apex arched; ambulacra almost straight, poriferous zone straight or very slightly flexuous; pore pairs unigeminal becoming bigemminal near the peristome; interambulacral areas wide; madreporic plate pentagonal; ocular plates small, triangular, exsert; genitals comparatively large, pentagonal.

3. New Unionids from the Triassic (Gondwana) Rocks of Tihki, Vindhya Pradesh and Maleri, Hyderabad, Deccan

M. R. Sahni and A. P. Tiwari have described for the first time, the only known Triassic unionid fauna from India. This includes the new genus *Tihkia* with much thickened shell. inconspicuous, anteriorly situated (not terminal) beaks, curved inward and forward; flat, smooth umbo; lunule, opisthodetic ligament and characteristically strong concentric corrugations in later stages. Pseudocardinals prominent.

Species: *T. corrugata*, with sharp upward anterior curvature moderate inflation, prominent, elongate opisthodetic ligament. *T. navis*: inflated, subquadrate, boat-shaped. *T. compressa* is broadly oval and compressed. *T. subangulata* is subtriangular and characterised by an oblique external ridge.

4. Discovery of *Eurydesma* and *Conularia* Horizons in the Eastern Himalaya and Description of Their Faunas

M. R. Sahni and J. P. Srivastava record the discovery of *Eurydesma* beds in Sikkim, E. Himalaya and of a *Conularia*-bearing horizon in the Subansiri Division, N.E.F. Agency. The Sikkim fauna represents the Agglomeratic slate horizon of Kashmir with which the beds are lithologically identical,

lished by permission of the Director, Geological f India.

A few errors are present which, it is hoped, will be eliminated in subsequent editions of the book. The inaccurate stoichiometric equation on p. 28 for oxidation of ethanol to acetic acid, the misleading statement on p. 82 that 'dimedone is.....a reagent for the preparation of aldehydes', and the description on p. 68 of the group NH-AC as acetylimino are errors which need to be corrected. Furthermore, a desirable improvement would be to state the standard yield obtained for each preparation, so that the student can evaluate his own technique.

These are only by the way, and the book will no doubt be found useful by students and teachers alike of preparative organic chemistry. S. SWAMINATHAN.

The Plant Quarantine Problem. By W. A. McCubbin. (Ejnar Munksgaard, Copenhagen.) Pp. 255. Price 34 *sh.* 6 *d.*

The author, who has a long experience of plant quarantine work in the U.S.A., has expounded in lucid style the principles and problems of plant quarantine. Although the literature of this subject is available from widely scattered sources, it is often concerned with particular phases of plant quarantine and no one has yet undertaken to present the subject as a composite whole, bringing together all its aspects in such a form as to constitute an overall review. The author in his present book has admirably succeeded in doing so.

The subject-matter of the book has been discussed in eight chapters: Introduction, The Biological Background, Social and Economic Relations, Legal Features, Administrative Aspect, Current Quarantine Problems Examined, Appraisal and Outlook and World Situation. There is an Appendix entitled 'The Historical Summary of Federal Plant Disease Quarantines'. The view-points presented in the book are mainly with reference to quarantine problems of the U.S.A., but the general considerations and conclusions would be of equal interest to other countries.

Plant quarantine is essentially a national undertaking and its effects are far-reaching on the agricultural economy of a country. Numerous examples of widespread destruction in the U.S.A. caused by introduced pests have been cited, much of which could have been prevented by timely action. There is a growing awareness in many countries of the benefits of plant quarantine. Although the book does not mention the efforts made towards international co-operation by the F.A.O. in 1951 in plant quarantine work and in the establishment of Regional Plant Protection Conventions, the publication of this book by Dr. McCubbin will doubtlessly stimulate wider interest in the subject. P. R. MEHTA.

Tissue Culture Technique in Pharmacology. By C. M. Pomerat and 49 other authors. *(Annals of the New York Academy of Sciences)*, Vol. 58, Art. 7, pp. 356. Price $ 4.50.

This symposium on "Tissue Culture Technique in Pharmacology" is of great interest not only to the pharmacologist but also to the virologist, the histopathologist and the clinician.

Tissue culture technique, an innovation introduced by Harrison in 1907, has opened up a fertile field for investigating the action of drugs on various types of cells (single cells, mass cultures, and organ cultures; normal and malignant cells, etc.), under varying conditions. Not only do we learn something new about drug action but of greater importance, we are given an inner glimpse of the function of subcellular structures in living cells. The value of tissue culture to the study of viruses and antibody formation is immense.

The utility of tissue culture technique in pharmacology, its advantages and limitations are revealed in this symposium. The effects of drugs on cell division, growth and intracellular morphological changes, metabolism and motility are studied yielding valuable information. The isolation, management, stability and use of strains of various normal and malignant cells are described, promoting better understanding of the biology of many diseases and growth processes at cellular level. The symposium is replete with data concerning the types of cells chosen for culture, culture media and their modifications, adaptation of apparatuses, etc., of immense value to the virologist and the cytologist. Adaptation of tissue culture technique for the production and assay of viruses and their antibodies is envisaged. A number of papers are devoted to the use of tissue culture technique for the screening of drugs as to their tissue toxicity, anti-neoplastic activity, cell-sensitivity, etc. The reasons for the failure of antibiotic therapy in certain infections are investigated by studying the actions of chemotherapeutic and antibiotic agents on intracellular bacteria. The symposium also contains a number of descriptive and elucidative photomicrographs and time-lapse phase-contrast cine-photomicrographs.

M. N. GURUSWAMI.

SPANISH WHEATS*

THIS is a most interesting book dealing with a difficult subject in a masterly way. The aim of the author may be gauged from a few paragraphs from the Introduction. "Wheat in Spain has always been the most widely cultivated plant and of the greatest economic importance. The varieties of Spanish wheat go into the hundreds as a result of the special geographical position of the Spanish Peninsula, of the many peoples that in the course of centuries have passed through it, of the isolation imposed on various agricultural zones by the complicated mountain chains. The Spanish Peninsula is therefore a veritable genetical treasure-house of incalculable value. Unfortunately in recent times there has started a gradual loss of native wheat forms, induced by such causes as the greater facility of communications, the interchange of seeds, the abundant seed distribution carried out by official bodies, etc....."

The author has spent years in collecting every possible type of wheat from every corner of Spain; his aim was not only to satisfy the curiosity of a botanist, but also to search for genetical material for the improvement of the wheat crops in the country.

The book consists of twelve chapters. Chapter I gives a very detailed description of all the parts of the wheat plant that are usually taken into consideration in the systematic classification of the genus. Chapter II gives an artificial key of all the species cultivated in Spain; the key is based on that of Flaksberger. Chapters III-X deal with the following species of wheat in Spain: *T. vulgare* Host., *Compactum* Host., *Durum* Desf., *Turgidum* L., *Polonicum* L., *Dicoccum* Schübl., *Monococcum* L., *Spelta* L.

To give an idea of the treatment of these various species, we may take Chapter III for detailed notice. It deals with *Triticum vulgare* Host. The author follows Vavilov in splitting the species into two groups, *ligulatum* and *eligulatum*; each of these groups is again divided into sub-groups: *Muticum* Alef., *Aristatum* Alef., *Breviaristatum* Alef. and *Inflatum* Flaks.; there then follows a key to the varieties under each of these sub-groups. From p. 39 onwards the author deals with the races of Spanish wheats under each of the varieties mentioned by Flaksberger. After an artificial key for the variety, the following points are given for each of the races: common local name, locality where the race grows, general characters, leaves, culms, ears, glumes, grain, field characters such as resistance to fungal pests, time from anthesis to ripening, short note on qualities for the preparation of bread.

Chapter XI is a summary of the details discussed in the previous eight chapters, giving the "geographical distribution of wheat varieties and races by regions and provinces"; it is a list where against the various provinces of the country are given the common or vernacular names and the equivalent scientific species and variety names.

Of the 80 plates in the book, two show the harvesting of wheat, and are of little interest; the rest show ears of wheat with some close-up photos to show details of the glumes, etc. Botanically the plates are very interesting and clear, and artistically they are a model of the photographer's art. The printing is neat and the whole book is a pleasure to the eye.

A few points on the negative side may also be mentioned. The scientific names are usually separated by a comma from those of the authors, a practice that is not recommended by the International Code of Botanical Nomenclature, though it was the general practice a few years ago. In the text occasionally specific names are capitalized (*e.g.*, on page 25), and the author's name is given in what appears to be Spanish (*e.g.*, on page 25, "*Triticum Polonicum*, Linneo"). In the Bibliography there are a few mispellings of foreign words. In a book of this sort, one would have expected greater attention paid to the genetical constitution of the species and varieties; the chromosome constituents of the various species are given on page 25, the chromosome number being the basis of the classification of wheat species, but there is no further mention in the book of the chromosome details of any of the varieties or races studied.

In spite of these slight blemishes the book is recommended as a model of typographic and scientific ingenuity; it is certainly an improvement on G. Evans "Varieties of Wheat grown in the Central Provinces and Berar" (1908), and on Howard and Khan "The Wheats of Bihar and Orissa" (1922).

Botanical Survey of India, Calcutta. H. SANTAPAU.

* *Trigos Espanoles (Spanish Wheats)*. By Manuel Gadea (in Spanish). Published by the National Institute for Agricultural Research, Madrid, 1954, pp. xv + 453, price not given.

degradation of cellulose, the complete kinetic analysis of degradation of cellulose and radical chains of various monomers has been dealt with.

The mathematical treatment throughout the book is very detailed and embodies the full significance of the complexities of chain reactions. The topics of branching and cross-linking are slightly touched upon. With such valuable and up-to-date information the book will be of special value to physical chemists and particularly to high polymer research chemists.

M. SANTHAPPA.

Electromagnetic Theory. By V. C. A. Ferraro, University of London. (The Athlone Press), 1954. Pp. viii + 555. Price 42 *sh.*

This is admirably suited to be a text-book for students taking Electromagnetic Theory as their special subject for the Honours or Masters Degree in Mathematics. Part I deals with the basic principles of electrostatics and electrodynamics. Part II on boundary-value problems is concerned with the mathematical theory of determining potential distributions given specific boundary conditions, in particular the use of spherical and spheroidal harmonics. Part III contains a discussion of electromagnetic phenomena, with particular stress on the essential mathematical aspects, leaving out topics of purely physical interest such as the electrodynamics of moving media and the electron theory of dispersion.

The treatment is throughout very clear and elegant and the printing leaves nothing to be desired. Vector notation has been used systematically, and the first chapter covers those portions of this subject which are needed later. Each chapter has, appended to it, a large number of examples, and these greatly add to the usefulness of the book as a text-book. Although written specifically for the mathematician, it will also serve well as a reference book for physicists and engineers.

Mass Balancing of Aircraft Control Surfaces. By Templeton. (Chapman & Hall), 1954. Pp. x + 241. Price 35 *sh.*

A good amount of work has been done on the subject of mass balancing of aircraft control surfaces, and a need for a systematic presentation of the published data in the form of a text-book has long been felt. The monograph published under the authority of the Royal Aeronautical Society can easily meet the requirements of a text-book on that subject.

Part I of the book provides in a lucid style an understanding of the basic principles employed in the application of mass balancing to prevent flutter of aircraft control surfaces. Part II of the book gives a historical review of the work done in Britain on that subject with additional chapters on design requirements for mass balancing and the procedure adopted in practice. Another chapter gives the various methods adopted for mass balancing. Part III gives a short note on the possible future developments and discusses the limitations in and alternatives for mass balancing.

Unfortunately the monograph is limited purely to British work on the subject. Yet it is adequate for the requirements of a text-book for a Graduate in Aeronautical Engineering. The recent developments on the subject in the United States of America could have been added in Part III. In spite of this limitation, the book, because of the good presentation of the subject-matter, should be welcome to all those engaged in Aeronautical Engineering either in industries or educational institutions.

N. SRINIVASAN.

Chemical Pathways of Metabolism, Vol. I. Edited by D. M. Greenberg. Pp. xi + 460. Price $ 11.00; Vol. II: Pp. x + 383. Price $ 9.50.

Intense research activity in biochemistry in various directions has necessitated in recent years the publication of books containing review articles, which aim at integrating the work carried out on different aspects of one and the same problem. The efforts of Dr. Greenberg in editing two such volumes dealing with chemical pathways of metabolism may be considered as very praiseworthy indeed, particularly in the context of the wide variety of subjects covered in this extensive field of biochemical investigation. The topics which have been dealt with in Volume I are, Free energy and metabolism, by A. B. Pardee; Enzymes in metabolic sequences, by D. E. Green; Glycolysis, by P. K. Stumpf; The tricarboxylic acid cycle, by H. A. Krebs; Other pathways of carbohydrate metabolism, by S. S. Cohen; Biosynthesis of complex saccharides, by W. Z. Wassid; Fat metabolism and acetoacetate formation, by I. L. Chaikoff and G. W. Brown Jr.; and Sterol and steroid metabolism, by K. D. Fukushima and R. S. Rosenfeld. Three of the eight chapters in the second volume dealing with carbon catabolism of amino acids, synthetic processes involving amino acids and the

etabolism of sulphur containing compounds ve been written by the editor himself, while e remaining five are by (*i*) P. P. Cohen on trogen metabolism of amino acids, (*ii*) H.)rsook on enzymatic synthesis of peptide nds, (*iii*) M. P. Schulman on purines and rimidines, (*iv*) L. A. Heppel on nucleotides d nucleosides, and (*v*) S. Granick on metalism of leme and chlorophyll. Though some these articles are short and the literature vered in the first volume is only up to the iddle of 1953, the treatment of the different pics is uniformly good. Special mention may,)wever, be made of the very valuable contriition of Krebs on the tricarboxylic acid cycle, id the comprehensive review on the biosynesis of complex saccharides by Hassid. Grack has also dealt in great detail on the etabolic studies of leme and chlorophyll.

An error has crept in on p. 165 in the cond volume, wherein it is stated that the ructural formula of coenzyme A is shown in age 149, whereas no formula of any kind is ven in the page referred to. In the chapter n the metabolism of amino acids, the work A. Butenandt and his associates could have een described in the section dealing with yptophane metabolism. However, subjects ke glycine-serine and other interconversions, ne biosynthesis of branched chain amino acids nd the aromatic amino acids have been writen by Dr. Greenberg in an elegant fashion and onstitute a veritable mine of useful informaion. One may perhaps take exception to the ractice of some of the authors quoting from roceedings of learned societies since such eferences are not easily available for consulation and more often do not give much etailed information. However, in spite of nese minor drawbacks, the volumes as a whole re excellent in their scope and content, and ery well got up. They should help biochemists ll the world over in their investigations of he several pathways of metabolism. To the eacher in biochemistry, the two volumes are valuable for his lectures on the various spects of metabolism.

P. S. Sarma.

The Production and Use of Power Alcohol in Asia and the Far East. (The Economic Commission for Asia and the Far East, United Nations), 1954. Pp. 445. Price not given.

The above is a report on the Regional Seminar on the production and use of power alcohol held in Lucknow from 23rd October to 6th November 1952. It covers the deliberations and discussions of the participating experts in the Seminar, and will be of immense use to specialists and industrialists associated with power alcohol.

Liquid-Liquid Extraction. By L. Alders. (Published by Elsevier Publishing Company, Amsterdam), 1955. Pp. x + 206. Price 32 *sh.*

The book provides systematic and detailed knowledge of the theory of liquid-liquid extraction and describes the various methods of investigation concerned with liquid-liquid extraction processes. A survey is given of the principal extraction procedures, *viz.*, cross-current extraction, two solvent extraction and extraction with reflux. Experimental methods have been suggested for determining the phase equilibrium data which are necessary for the design calculations. The author has not dealt with any special features of the Chemical Engineering side of liquid-liquid extraction, nor is any commercial equipment described. Information on such subjects, however, is already available in "Liquid Extraction" by R. E. Treybal, "Absorption and Extraction" by T. K. Sherwood and R. L. Pigford, etc. The author has treated this specialised subject in the simplest possible manner and the book offers a great wealth of information. It is an excellent manual of technique for all investigators concerned with liquid-liquid extraction and will be very useful to all chemical investigators in research institutions and industries interested in this field.

G. S. Laddha.

Books Received

The Relation of Immunology to Tissue Homotransplantation. By J. M. Converse and 34 others. (*Annals of the New York Academy of Sciences,* Vol. 59, Art. 3). Pp. 190. Price $ 4.00.

Ionizing Radiation and the Cell. By L. F. Nims and 22 others. (*Annals of the New York Academy of Sciences,* Vol. 59, Art. 4). Pp. 200. Price $ 4.00.

Protective Current Transformers and Circuits. By P. Mathews. (Chapman & Hall), 1955. Pp. xv + 253. Price 36 *sh.*

Precast Concrete. By Kurt Billig. (Macmillan & Co.), 1955. Pp. xvi + 341. Price 32 *sh.*

Progress in Nuclear Physics, Vol. 4. Edited by O. R. Frisch. (Pergamon Press), 1955. Pp. vii + 379. Price 70 *sh.*

A few errors are present which, it is hoped, will be eliminated in subsequent editions of the book. The inaccurate stoichiometric equation on p. 28 for oxidation of ethanol to acetic acid, the misleading statement on p. 82 that 'dimedone is.....a reagent for the preparation of aldehydes', and the description on p. 68 of the group NH-AC as acetylimino are errors which need to be corrected. Furthermore, a desirable improvement would be to state the standard yield obtained for each preparation, so that the student can evaluate his own technique.

These are only by the way, and the book will no doubt be found useful by students and teachers alike of preparative organic chemistry. S. SWAMINATHAN.

The Plant Quarantine Problem. By W. A. McCubbin. (Ejnar Munksgaard, Copenhagen.) Pp. 255. Price 34 *sh.* 6 *d.*

The author, who has a long experience of plant quarantine work in the U.S.A., has expounded in lucid style the principles and problems of plant quarantine. Although the literature of this subject is available from widely scattered sources, it is often concerned with particular phases of plant quarantine and no one has yet undertaken to present the subject as a composite whole, bringing together all its aspects in such a form as to constitute an overall review. The author in his present book has admirably succeeded in doing so.

The subject-matter of the book has been discussed in eight chapters: Introduction, The Biological Background, Social and Economic Relations, Legal Features, Administrative Aspect, Current Quarantine Problems Examined, Appraisal and Outlook and World Situation. There is an Appendix entitled 'The Historical Summary of Federal Plant Disease Quarantines'. The view-points presented in the book are mainly with reference to quarantine problems of the U.S.A., but the general considerations and conclusions would be of equal interest to other countries.

Plant quarantine is essentially a national undertaking and its effects are far-reaching on the agricultural economy of a country. Numerous examples of widespread destruction in the U.S.A. caused by introduced pests have been cited, much of which could have been prevented by timely action. There is a growing awareness in many countries of the benefits of plant quarantine. Although the book does not mention the efforts made towards international co-operation by the F.A.O. in 1951 in plant quarantine work and in the establishment of Regional Plant Protection Conventions, the publication of this book by Dr. McCubbin will doubtlessly stimulate wider interest in the subject. P. R. MEHTA.

Tissue Culture Technique in Pharmacology By C. M. Pomerat and 49 other authors *(Annals of the New York Academy of Sciences)*, Vol. 58, Art. 7, pp. 356. Price $4.50.

This symposium on "Tissue Culture Technique in Pharmacology" is of great interest not only to the pharmacologist but also to the virologist, the histopathologist and the clinician.

Tissue culture technique, an innovation introduced by Harrison in 1907, has opened up a fertile field for investigating the action of drugs on various types of cells (single cells, mass cultures, and organ cultures; normal and malignant cells, etc.), under varying conditions. Not only do we learn something new about drug action but of greater importance we are given an inner glimpse of the function of subcellular structures in living cells. The value of tissue culture to the study of viruses and antibody formation is immense.

The utility of tissue culture technique in pharmacology, its advantages and limitations are revealed in this symposium. The effects of drugs on cell division, growth and intracellular morphological changes, metabolism and motility are studied yielding valuable information. The isolation, management, stability and use of strains of various normal and malignant cells are described, promoting better understanding of the biology of many diseases and growth processes at cellular level. The symposium is replete with data concerning the types of cells chosen for culture, culture media and their modifications, adaptation of apparatuses, etc., of immense value to the virologist and the cytologist. Adaptation of tissue culture technique for the production and assay of viruses and their antibodies is envisaged. A number of papers are devoted to the use of tissue culture technique for the screening of drugs as to their tissue toxicity, anti-neoplastic activity, cell-sensitivity, etc. The reasons for the failure of antibiotic therapy in certain infections are investigated by studying the actions of chemotherapeutic and antibiotic agents on intracellular bacteria. The symposium also contains a number of descriptive and elucidative photomicrographs and time-lapse phase-contrast cine-photomicrographs.

M. N. GURUSWAMI.

SPANISH WHEATS*

THIS is a most interesting book dealing with a difficult subject in a masterly way. The aim of the author may be gauged from a few paragraphs from the Introduction. "Wheat in Spain has always been the most widely cultivated plant and of the greatest economic importance. The varieties of Spanish wheat go into the hundreds as a result of the special geographical position of the Spanish Peninsula, of the many peoples that in the course of centuries have passed through it, of the isolation imposed on various agricultural zones by the complicated mountain chains. The Spanish Peninsula is therefore a veritable genetical treasure-house of incalculable value. Unfortunately in recent times there has started a gradual loss of native wheat forms, induced by such causes as the greater facility of communications, the interchange of seeds, the abundant seed distribution carried out by official bodies, etc....."

The author has spent years in collecting every possible type of wheat from every corner of Spain; his aim was not only to satisfy the curiosity of a botanist, but also to search for genetical material for the improvement of the wheat crops in the country.

The book consists of twelve chapters. Chapter I gives a very detailed description of all the parts of the wheat plant that are usually taken into consideration in the systematic classification of the genus. Chapter II gives an artificial key of all the species cultivated in Spain; the key is based on that of Flaksberger. Chapters III-X deal with the following species of wheat in Spain: *T. vulgare* Host., *Compactum* Host., *Durum* Desf., *Turgidum* L., *Polonicum* L., *Dicoccum* Schübl., *Monococcum* L., *Spelta* L.

To give an idea of the treatment of these various species, we may take Chapter III for detailed notice. It deals with *Triticum vulgare* Host. The author follows Vavilov in splitting the species into two groups, *ligulatum* and *eligulatum*; each of these groups is again divided into sub-groups: *Muticum* Alef., *Aristatum* Alef., *Breviaristatum* Alef. and *Inflatum* Flaks.; there then follows a key to the varieties under each of these sub-groups. From p. 39 onwards the author deals with the races of Spanish wheats under each of the varieties mentioned by Flaksberger. After an artificial key for the variety, the following points are given for each of the races: common local name, locality where the race grows, general characters, leaves, culms, ears, glumes, grain, field characters such as resistance to fungal pests, time from anthesis to ripening, short note on qualities for the preparation of bread.

Chapter XI is a summary of the details discussed in the previous eight chapters, giving the "geographical distribution of wheat varieties and races by regions and provinces"; it is a list where against the various provinces of the country are given the common or vernacular names and the equivalent scientific species and variety names.

Of the 80 plates in the book, two show the harvesting of wheat, and are of little interest; the rest show ears of wheat with some close-up photos to show details of the glumes, etc. Botanically the plates are very interesting and clear, and artistically they are a model of the photographer's art. The printing is neat and the whole book is a pleasure to the eye.

A few points on the negative side may also be mentioned. The scientific names are usually separated by a comma from those of the authors, a practice that is not recommended by the International Code of Botanical Nomenclature, though it was the general practice a few years ago. In the text occasionally specific names are capitalized (*e.g.*, on page 25), and the author's name is given in what appears to be Spanish (*e.g.*, on page 25, "*Triticum Polonicum*, Linneo"). In the Bibliography there are a few mispellings of foreign words. In a book of this sort, one would have expected greater attention paid to the genetical constitution of the species and varieties; the chromosome constituents of the various species are given on page 25, the chromosome number being the basis of the classification of wheat species, but there is no further mention in the book of the chromosome details of any of the varieties or races studied.

In spite of these slight blemishes the book is recommended as a model of typographic and scientific ingenuity; it is certainly an improvement on G. Evans "Varieties of Wheat grown in the Central Provinces and Berar" (1908), and on Howard and Khan "The Wheats of Bihar and Orissa" (1922).

Botanical Survey of India, Calcutta. H. SANTAPAU.

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metrical components as a background to the understanding of classes of network in protective systems. Conditions which give rise to negative and zero sequence components are discussed and methods of calculations of fault currents are indicated. Various types of relays and their classification according to different characteristics are described in a chapter on protective relays.

The chapter on neutral earthing deals with the comparison of isolated neutral and solid earthing systems and discusses the different systems of earthing through impedance and their application to meet the different requirements in power systems. The next two chapters deal with modern methods of protection of electrical machinery, busbars, feeders and transmission line. The present-day needs of protection of unit-operated generators and transformers are fully discussed. The development of modern high speed protection and carrier current protection for long transmission lines are also included.

The last chapter is devoted to the testing and maintenance of protective gear. It is rightly pointed out that the testing of protective gear comprehends not only that of the instrument transformers and relays which are the component parts of the gear, but also the checking of the correctness of the assembly of these components and their connections to form a protective circuit.

The bibliography includes reference to the English publications in journals and books related to the subject. Some references to Continental and American publications would have been helpful.

C. S. Ghosh.

The Testing of High Speed Internal Combustion Engines. By Arthur W. Judge. (Chapman & Hall, Ltd., London), 1955. Pp. xvi + 494. Price 75 *sh.*

This well-known book has been published in its fourth edition which has been revised and enlarged considerably taking into account new measuring methods and instruments. It has thus become a text-book on the testing of Internal Combustion Engines covering this wide and varied field in its major aspects.

The text is divided into fourteen chapters, the first two covering the general principles, mainly of the Otto petrol engine and its performance, and the test procedure adopted for ascertaining its output. The next two chapters review the details of measuring techniques adopted for metering the charge, *i.e.*, for the fuel and the exhaust gases (Chapter III), and for the air supply (Chapter IV). The cooling water system of test set-ups is considered next. The central portion of the book is devoted to the measurement of the output (Chapter VI) which is followed by a detailed treatment of pressure measurements and the types of indicators used (Chapters VII and VIII), with two more chapters devoted to cathode ray indicators and a discussion on indicator diagrams and their evaluation. A chapter on temperature measurements concludes this more specific portion of the book, which is followed by three chapters outlining particular items involved in the testing of Diesel engines, reciprocating aero engines and mainly aero gas turbines. The book concludes with a chapter on some special instruments and measuring methods applied in more serious work, say, for research and development, and a number of appendices dealing with test data evaluation, the international standard atmosphere, the SAE aircraft engine test code, and finally the calculations of the air-flow passing through standard throttle plates. The index allows quick reference especially in combination with the detailed list of contents.

The book conveys excellently the present state of instrumentation and measuring techniques adopted in this important field of mechanical engineering with its often complex and unusual features such as high pressures and extremely high temperatures sustained only for fractions of a second, and high speeds and accelerations. Considering the extent of the subject, it is understandable that mention could be made only of the most outstanding contributions, but work undertaken on the Continent has found but little attention. A few further suggestions are: operational data are given for the petrol engine (Chapter I) but hardly for the Diesel engine, and Chapter II on test procedure contains subjects which are repeated later in greater detail. The new chapter on testing of complete gas turbines and their components and accessories is rather general, and the information contained in the last chapter could be inserted earlier where similar instruments are considered. Many readers may be interested to have more exhaustive information on standard test codes of stationary or of automotive engines rather than aero engine testing, and, incidentally, may also wish for more references (*e.g.*, on page 19) and information on suppliers (*e.g.*, on page 229). Some small inaccuracies could be remedied in the next edition such as on

e 65, and in Fig. 4 on page 12, and Fig. 104 page 146. These shortcomings do not, howr, detract or diminish in any way the unique ue of the book for the student and the ous worker in this fascinating subject.

H. A. HAVEMANN.

dy of Madhya Pradesh Coals with Special :eference to Their Beneficiation and Caking 'roperties. By S. B. Pandya. (Published by ıe Nagpur University.) Pp. 108. Price Rs. 4.

While the contribution of Madhya Pradesh 'ards India's output of coal is just about , that State holds nearly 30% of our total l resources. The superiority of the coking ls obtainable from the collieries of Bihar . Bengal for metallurgical purposes has till v stood in the way of a proper exploitation Madhya Pradesh coal reserves. But with the ıblishment of the new steel factory in the te and with the further programme of ustrialisation envisaged in the Five-Year n, it may be expected that Madhya Pradesh l will come into its own in the near future. : publication of a monograph of this type M.P. coals is therefore meets a timely d.

he earlier chapters in the monograph ɔody the methods and results of systematic estigation on a large variety of coal samples ected from different localities in the State. : proximate analysis of some 107 samples . the calorific values and sulphur contents over 50 of these samples are tabulated in ; section. A scheme of grading of M.P. ls has been developed, which though based the scheme proposed by the Fuel Research titute, is claimed to be more systematic. : best coals according to this grading—ssified as 'Selected Grades A and B' and h price points in the range 75-81—come from North Chattisgarh fields or Korba area. ssification of coals has also been done on basis of their 'rank' or maturity, accordto Parr's classification and Specific Vola-Index Classification Schemes. The later pters include determination of the caking ices of raw, beneficiated and blended sam-s, and washability tests by float-and-sink :hod using benzene-carbon tetrachloride ctures. Conclusions have been drawn on suitability of different coal samples for ustrial utilization such as the manufacture metallurgical coke, soft coke for domestic poses, and of coke briquettes.

his useful and informative monograph will ımend itself to all engaged in coal research, and especially to those interested in developing Madhya Pradesh coal.

A. P. MADHAVAN NAIR.

Nutrition Research Laboratories—Annual Report for 1953-54. (Indian Council of Medical Research.) Pp. 27.

This booklet contains a report of the research work carried out at the Nutrition Research Laboratories, Coonoor, during 1953-54. As in previous reports, details of research work have been given of studies on vitamins, proteins, clinical investigations, pathology and field work, together with the titles of eighteen research papers published in India and abroad. It is stated that by the usual cooking procedures adopted in India, the losses in vitamin A varied between 10 and 47%, and not very much more as assumed by earlier workers. In regard to the mode of action of vitamin D, the conclusions drawn from the results so far obtained are interesting, but need confirmation, preferably by use of radioactive phosphorus and C^{14} labelled pyruvic and citric acids. A detailed study has also been made on body composition and basal metabolism, and the nutritional disease, "Kwashiorkar", has been further investigated. As regards studies on liver injury, the ideas put forward in lines 3 and 17 on p. 21 appear conflicting. In view of the recent reports on the biochemical importance of trace elements like molybdenum, parallel studies can profitably be carried out on some trace elements, particularly in experimental investigations of liver injury in rats. There is, however, no denying the fact that some very useful results have been obtained by the research group in Coonoor in both the fields of experimental and clinical nutrition, and one can look forward with confidence to more significant contributions in the future.

P. S. SARMA.

Semi-Micro Organic Preparations. By J. H. Wilkinson. (Oliver and Boyd, 98, Great Russel Street W. 1, London), Pp. x + 94. Price 8 *sh.* 6 *d.*

The above book describes a number of organic preparations involving the use of small-scale apparatus and semi-micro techniques. The advantages of the adoption of semi-micro techniques in preparative work are not so well recognised as in quantitative work, and the present work is meant to provide training in such techniques for beginners. The preparations included are varied in character and illustrate the different techniques employed.

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Wilt of Gram (Cicer arietinum *L.*) *in Bihar*—J. N. MISHRA

INVESTIGATION OF VERTICAL MOVEMENTS OF THE F_2 LAYER

PERIODIC fading of short wave radio signals in the early morning and late evening hours was interpreted by the previous workers[1,2] as due to the interference of two waves either singly and doubly reflected from one layer or singly reflected from two different layers (E and F_2) when one or both the layers have a slow vertical movement. When the received signal consists of singly reflected waves from both the layers, they have assumed that both the layers will move with the same velocity. Si the F_2 layer is known to have larger hei variations than the E layer, it is felt that assumption made above is not quite justifi So, by taking the vertical velocities of the t layers to be different, the formula was mo fied from which the F_2 layer velocity can determined by substituting the previou known value of the E layer velocity obtai from medium wave records taken during same time. The modified formula takes form

$$n = (2/\lambda)\,(v_1 \cos \phi_1 - v_2 \cos \theta_1)$$

where n is the fading frequency, λ is the wavelength of the received signal, ϕ_1 and θ_1 are the angles of incidence of the two rays on the F_2 and E layers of the Ionosphere and v_1 and v_2 are the respective vertical velocities of the two layers. Substituting the E layer vertical velocity obtained from medium wave records taken separately during the same time, we can easily calculate v_1 if we determine the periodicity in a short wave fading record.

Madras B transmitting station radiating on 4920 Kc/s. was selected and the signals were recorded with the usual c.w. recording technique in the evening hours at about 6 O' clock and it was found that the condition was favourable to receive both the singly reflected waves from the two layers. The average value of the layer lifting velocities for the E layer during the month of October 1953, in the evening hours was found to be 2·3 metres/s. Using this value the layer lifting velocities for the F_2 layer obtained on three typical days are shown in the table.

S. No.	Date	Period in secs.	Velocity m./s.
1	8-10-53	14·7	3·7
2	8-10-53	16·1	3·45
3	9-10-53	19·4	3·02
4	9-10-53	16·0	3·47
5	10-10-53	18·2	3·16

From the table it is evident that F_2 layer velocity is definitely greater than that of E layer as was expected. More reliable values for F_2 layer velocities can be obtained by taking simultaneous records on short and medium waves from the same station so that the exact E layer velocity during the same time may be determined. The results thus obtained for the F_2 layer velocity can be checked by obtaining records showing periodicities due to the interference of $1F_2$ and $2F_2$ reflections from the layer. The full details of these investigations will be published elsewhere. The author has great pleasure in expressing his gratitude towards Dr. B. Ramachandra Rao for his kind and inspiring guidance.

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TEMPERATURE DEPENDENCE OF THE MAGNETIC SUSCEPTIBILITY OF SODIUM AND POTASSIUM

THE study of the magnetic susceptibility of the alkali metals has assumed great interest in recent years because of the theoretical importance from the point of view of the weak spin paramagnetism of the conduction electrons in metals. Several authors have previously studied the susceptibilities of the alkali metals but their values show a large disparity among one another and with the values calculated from theoretical considerations. Also, with regard to the study of the variation of the susceptibility of these metals with temperature, the results so far available are very divergent in nature and as such no definite conclusions could be arrived at.

In the present investigation a study of the susceptibilities of sodium and potassium has been made between room temperature and about 120° C. by the Curie method using a large electromagnet of Pye type. Pure oxide-free metals were used in the test bulbs. Also a correction for any ferromagnetic impurity that might be contained in the metal has been applied for every bulb experimented upon using the method of Honda and Owen.[1] The average specific susceptibility values for Na and K at room temperature as obtained in this investigation are $+0{\cdot}575$ and $+0{\cdot}455$ respectively.

Three Na bulbs and three K bulbs were subjected to temperature variation from 30° C. to 120° C., *i.e.*, over a short range on either side of their melting points. The heating was done by an electrical heater and the temperatures were measured by a previously calibrated thermo-couple. At every temperature, the susceptibility was found at different field strengths and the correction for the ferromagnetic impurities was applied to each bulb. Table I summarises the values obtained in this investigation.

TABLE I

Sodium		Potassium	
Temperature ° C.	$\chi \times 10^6$	Temperature ° C.	$\chi \times 10^6$
30	·575	30	·450
50	·575	42	·450
67	·580	58	·460
84	·590	67	·435
94	·600	86	·435
105	·560	105	·440
120	·560		

about 650 μ in length with its walls composed of columnar cells with layers of nuclei. The organ is enveloped by a thick capillary plexus. The entire organ is separated from the parapHysis by a narrow space representing the dorsal sac.

A detailed study of the relations of the parietal organ, the neurosecretory centre of the paraphysis and the endocrine epiphysis is in progress.

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ENZYME COMPLEX OF THE CORPUS ALLATUM OF THE FEMALE *IPHITA LIMBATA* STAL.

A PRELIMINARY note on the structure and changes of the corpus allatum of the female plant bug *Iphita limbata* Stal. (Pyrrhocoridæ : Hemiptera) was published by the author.[1] No work has so far been done on the enzyme complex of the neurosecretory system of invertebrates.[2] The corpus allatum, which forms part of the pars intercerebralis-cardaicum-allatum system of the neurosecretory endocrine organs, shows marked changes in the secretory activity as the female starts mating and eggs begin to develop, reaching the maximum size as the insect becomes gravid. After oviposition the corpus allatum shrinks slowly.

This enlargement of the corpus allatum is also associated with an increase in the development of the enzyme content of the gland. Two enzymes, *viz.*, acid phosphatase and succinic dehydrogenase, gradually increase in amount as the corpus allatum enlarges. The maximum concentration occurs in the gravid female.

Gomori's technique as recommended in his recent book[3] has been employed for the study of acid phosphatase, control material being inactivated by either Lugol's iodine or boiling water. Incubation for six hours at 37° C. gave the best results. Seligman and Rutenberg's[4] method using blue tetrazolium and Shelton and Schneider's (Pearse[5]) method using neotetrazolium were used for the study of succinic dehydrogenase, control material being incubated with sodium malonate added to the ture. Freshly dissected corpora allata been used in the studies.

In the newly moulted female imago, the pus allatum shows the nuclei as seats of phosphatase. In that of the female whic mating and where eggs are developing, be the nuclei there are granules indicating sit

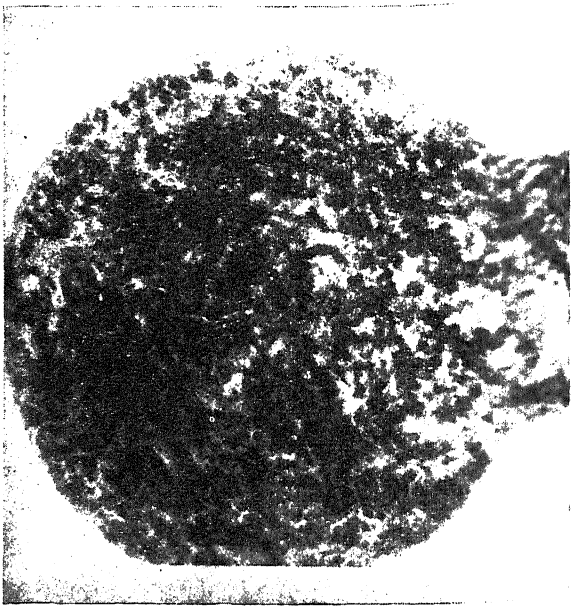


FIG. 1. Corpus allatum of the female *Iphita lim* Stal., twelve hours after oviposition, to show the sit acid phosphatase activity. The dark rounded bodi the nuclei, the black patchy regions and granul localisations of the enzyme in the cytoplasm. Incub time 370 minutes. Approximately, × 75.

acid phosphatase in the cytoplasm. In the vid female, the black granular material is tributed in the cytoplasm in large quanti showing a high concentration of the enz After oviposition, the enzyme content of gland remains practically the same (Fig.

Newly emerged imagines show practically positive indication of succinic dehydroge in the corpus allatum. But in the mi female where the corpus allatum is enlar well-defined particles indicating sites of su nic dehydrogenase activity make their app ance. A large number of blue diformaz particles and few monoformazan granules in the cytoplasm, especially along the ma of the gland and near the allatic nerve. In the gravid female, with highly distended ab men and mature eggs, the cytoplasm sh very high concentrations of the enzy demonstrable by both the methods. There

myriads of blue (or purple in Shelton and Schneider's method) granules in the cytoplasm and where the entire gland is incubated, concretions of these granules occur as large and conspicuous colloids (Fig. 2). The nuclei appear

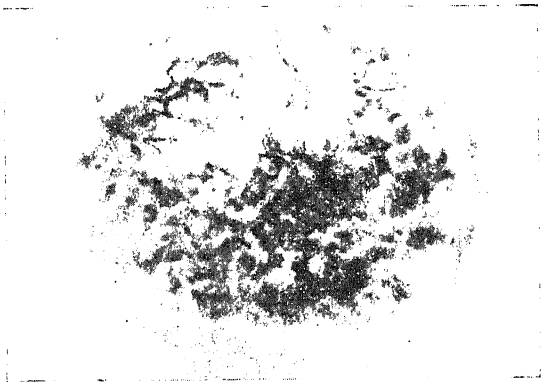


FIG. 2. Corpus allatum of the gravid female, showing sites of succinic dehydrogenase activity. Shelton and Schneider's method. Incubation time 40 minutes. The colour developed in three minutes. Approximately, ×55.

as transparent vesicles. There is a marked fall in the enzyme content as oviposition occurs.

More detailed investigations on the cyclical development of the enzymes in the corpus allatum and the relationship between the dehydrogenase system and the oxidases in the blood of the female, are in progress.

I am indebted to Prof. C. M. Francis, Medical College, Trivandrum, for the gift of tetrazolium used in this study.

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THE CERVICAL EXTENSIONS OF THE THYMUS IN *LORIS LYDEKKERIANUS* (CABR.) AND THEIR SIGNIFICANCE

LORISOIDS exhibit a number of primitive features of anatomy. Some authors[6,7] consider them as truly primitive, while others[1,3,1] regard them as secondary simplifications consequent on sedentary habit. While examining the thymus of *Loris lydekkerianus*, it was discovered that in the embryo of this prosimian, the thymus extended into the cervical region and was lymphoidal, thus offering a condition which must be regarded as primitive.

The thymus of *Loris lydekkerianus* is well developed in the fœtus and also in young individuals. It consists, on each side, of a main part, located in the thorax, which gives off anteriorly, a cervical extension reaching up to the thyroid gland. This extension is made up of 5-6 distinct lobes. Each lobe is lymphoidal in nature, is enclosed by a thin compact capsular wall and shows a clear demarcation between cortex and medulla (Fig. 1). The cortex is

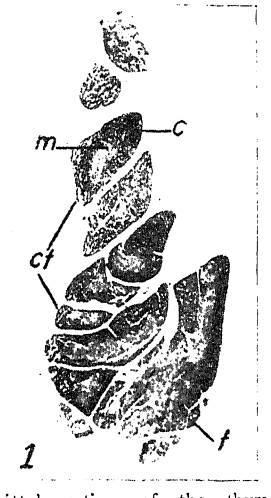


FIG. 1. Sagittal section of the thymus of *Loris* embryo (CR length=30 mm.) showing its lobulated lymphoidal cervical extension, × 11. *c*=Cortex; *ct*=Cervical thymus; *m*=Medulla; *t*=Thoracic thymus.

made of thymocytes, while the medulla consists of reticular cells, thymocytes, basophilic granulocytes and simple plasmodial Hassall's corpuscles.

The lymphoidal nature of the cervical thymus in *Loris lydekkerianus* has great significance. In a higher mammal like *Loris* it is an indication of the persistence of a primitive character. It is well known that in lower vertebrates[2,8,9] the thymus is lymphoidal in embryonic and larval conditions and is jugular in position. But in mammals, due to elongation of the cervical region, the main portion of the thymus migrates to the thorax leaving remnants of thymic tissue in the cervical region. Generally this cervical portion is a simple epithelial cord and is not lymphoidal in nature (except in ungulates[10]) and disappears very early.[4,5] The persistence of a well developed lymphoidal cervical thymus in *Loris lydekkerianus* embryo and young is indicative of a

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